MINXRAY INC.®

HF120/60HPPWV PowerPlus™
SERVICE MANUAL

1st edition (14, February 2005)

This manual is established for repair and adjustment of the MinXray model *HF120/60HPPWV* portable x-ray unit. Copy and transfer without notice is prohibited.

Section	Contents	Page
1.0	Introduction	1
2.0	Device history	2
3.0	Specifications	3
4.0	Operating procedures	5
5.0	Main parts	7
6.0	Pre-adjustment	9
7.0	Re-adjustment of kV	13
8.0	Re-adjustment of mA	15
9.0	Re-adjustment of pre-heat value	17
10.0	Re-adjustment of exposure time	20
11.0	Sample of output waveform	21
14.0	Measure mA by mA jack output	24
15.0	Wiring diagram	25
16.0	Schematic diagram	26
17.0	Trouble - shooting guide	35
18.0	Standard data	38
Appendix.	Parts list	

16.0 STANDERD TEST DATA

LEAKAGE RADIATION

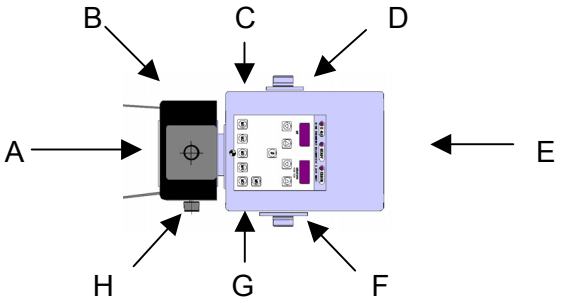
a. Test method:

1. Set kV to 120 kV, and timer to 1.0 sec.
2. Set x-ray dosemeter as following settings.
   distance: 1 m, range: 0 – 0.1 mR ionization chamber: 35^3 cm
3. Set chamber as following direction.
4. Close collimator set, and make exposure.
5. Measure value of mR.

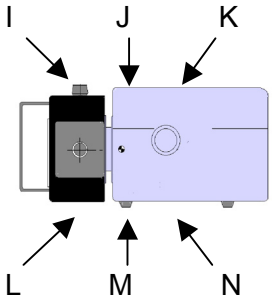
Calculations: mR/h = (raw test data) mR × 3600 × (duty cycle)1 / 60

b. Instruments: Model 37D Portable X-ray dosemeter Serial No. 5 - 6
Manufactured by D. A. Pitman Ltd.,

top veiw



side view



c. Sample raw test data:

	A	B	C	D	E	F	**G**
mR	0.004	0.011	0.016	0.006	0.005	0.004	0.042
	H	I	J	K	**L**	M	N
mR	0.016	0.048	0.030	0.009	**0.044**	0.028	0.008

d. Calculations: mR/h = (raw test data)mR x 3600 x (duty cycle) 1/60

	A	B	C	D	E	F	**G**
mR/h	0.24	0.66	0.96	0.36	0.30	0.24	2.52
	H	I	J	K	**L**	M	N
mR/h	0.96	2.88	1.80	0.54	**2.64**	1.68	0.48

1.0 INTRODUCTION

This service manual is for the MinXray model *HF120/60HPPWV* PowerPlus™ x-ray unit.
If you have any questions or need further assistance, please contact us. We are available Monday - Friday, 8:30 - 17:00 Central Time.

Service Department
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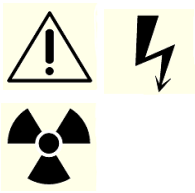


Always connect the power cord to a grounded AC mains electrical outlet.
High voltage is present in some internal components.
X-radiation is emitted during some calibration tests described within this manual.
Observe radiation safety precautions when conducting these tests.

CARELESS OR IMPROPER USE OF X-RAY EQUIPMENT CAN BE EXTREMELY HAZARDOUS. It is imperative that this equipment be operated and serviced only by trained personnel familiar with the safety precautions required to prevent excessive exposure to primary and secondary radiation, the dangers of exposure to x-radiation, and the proper use of the equipment and instrumentation discussed in this manual. All personnel authorized to operate or service this equipment should be fully acquainted with the established maximum permissible doses, safety recommendations and procedures for working with high voltage components, and testing and calibration instrumentation.

Although this x-ray unit incorporates protective design features for limiting both the direct (primary) x-ray beam and the secondary radiation produced by this beam, design factors alone cannot prevent human carelessness, negligence, or lack of knowledge. This apparatus is sold with the understanding that the user assumes sole responsibility for radiation and electrical safety, and that MinXray, Inc., its agents and representatives, do not accept any responsibility for:

1. Injury or danger to patient or other personnel from x-ray exposure or electrical shock.
2. Overexposure due to poor operating techniques or procedures.
3. Equipment not properly serviced, installed, or maintained in accordance with operation and service manuals.
4. Equipment which has been modified or tampered with in any way.

2.0 DEVICE HISTORY

Item No.	Contents	Start Serial No.
1	Pre-production (5 sets)	28151

3.0 SPECIFICATIONS

POWER : Range ---------- 100 ～ 260VAC

Minimum voltage with no load --------- 100VAC

Maximum voltage with no load -------- 260VAC

Frequency ---------- 50/60Hz

Electricity consumption ----------

	Minimum	Maximum
120V	19A(120kV)	30A(50kV)
230V	9A(120kV)	16A(50kV)

Maximum voltage consumption -------- 3.5kVA ±10%

Line Voltage regulation ---------- 4.8%

OUTPUT : Inverter : 3 kW ・ 40 kHz high frequency inverter system with neutral ground
tube potential feedback system
tolerance ±10%

Filament circuit : 0.5 Watt ・ 45 kHz inverter
tube current feedback system
tolerance ±10%
pre-heat time : approximately 3 sec.

X-RAY OUTPUT :

Tube voltage : tolerance ±10%

Maximum tube voltage : 120 kV
Minimum tube voltage : 40 kV
kV switch : 2 kV step

Tube current : tolerance ±20%

60 mA(0.01-0.1sec), 42 mA (0.11 – 5.0sec) @ 40 - 50 kVDC
50 mA(0.01-0.1sec), 35 mA (0.11 – 5.0sec) @ 52 - 60 kVDC
45 mA(0.01-0.1sec), 31.5 mA (0.11 – 5.0sec) @ 62 - 70 kVDC
38 mA(0.01-0.1sec), 26.6 mA (0.11 – 5.0sec) @ 72 - 80 kVDC
33 mA(0.01-0.1sec), 23.1 mA (0.11 – 5.0sec) @ 82 - 90 kVDC
30 mA(0.01-0.1sec), 21 mA (0.11 – 5.0sec) @ 92 - 100 kVDC
20 mA(0.01-0.1sec), 14 mA (0.11 – 5.0sec) @ 102 - 120 kVDC

Exposure timer : tolerance ±10%+1msec

0.01 – 0.2 sec. 0.01sec step
0.2 – 0.5 sec. 0.02sec step
0.5 – 1.0 sec. 0.05sec step
1.0 – 5.0 sec. 0.1sec step

X-RAY TUBE : Superior x-ray SXR-130-15-1.2

focal spot size : 1.2 mm × 1.2 mm

target material : tungsten

target angle : 14°

anode heat storage capacity : 65kHU

COLLIMATOR : Advantech Model R72/32

Continuously adjustable light beam type with central ray indicator, and cassette size/distance indicator to aid in correct positioning.

On time :	30 sec.
Bulb :	OSRM HLX-100W-12V
illuminance :	over 160 lux at 1 m SID
Contrast ratio :	over 3:1 at 1 m SID

FILTRATION :	inherent filtration(tube head)	2.2 mm Al
	collimator filtration	1.0 mm Al
	total filtration	3.2 mm Al

WEIGHT : 38.6lbs (17.51 kgs)

SIZE : 11.5”(29.2 cm) W × 8.81” (22.4 cm) H ×16.25” (41.3 cm) L

POWER CORD : 20 feet (6.1m)

EXPOSURE SWITCH CORD : 25 feet (7.6 m)

FUSE : 30A @ 125V

Specifications subject to change without notice.

4.0 OPERATING PROCEDURES

CONNECTION : After confirming POWER CORD and EXPOSURE SWITCH are intact, securely connect them to main body of x-ray unit.
(If connector has lock, confirm it is locked.)
Confirm POWER SWITCH is OFF and connect POWER CORD to wall outlet or wall socket of proper mains.
(When you use an extension cord, 3.5 kW should be obtained.)

POWER ON : Set POWER SWITCH on the back of the *HF120/60H* to ON.
Each indicator will illuminate.

DO NOT SWITCH ON AND OFF QUICKLY IN A SHORT TIME. WHEN TURNING ON AGAIN AFTER TURNING OFF, WAIT FOR AT LEAST 1 MINUTE. OTHERWISE, THE HIGH FREQUENCY INVERTER CANNOT WORK PROPERLY.

kV SETTING : Set kV in the range of 40 kV to 120 kV.

TIMER SETTING : Set timer in the range of 0.01 sec. to 5.00 sec. depending on subject, distance and screen/film combination.

mA SETTING : No adjustment.

SELECTION OF sec OR mAs INDICATION:
You can choose the sec or mAs indication by the switch.
(refer page 8.)

MEMORY FOR TECHNIC FACTOR:
Five different technique settings can be stored in memory for quick recall on the HF120/60H PowerPlus. To store a technique setting, press the Memory Storage button MR then press memory Recall button M1. This will store the technique setting displayed in memory position M1. Repeat this process for storing the different technique setting in M2-M5 as desired. Stored technique settings can be easily recalled by simply pressing M1-M5.

SOURCE-IMAGE DISTANCE:
Use the tape measure on the side of the *HF120/60H* to confirm that the x-ray unit is positioned at the correct source-image distance (SID) for the view being taken.

ADJUSTMENT OF RADIATION FIELD :
Pressing the collimator switch will illuminate the field for approx. 30 sec. Adjust light field to position of radiograph by two knobs for adjustment of opening. During this time, use the adjustment knobs to size the radiograph.

RADIOGRAPHY :

All safety checks, press only first stage of EXPOSURE SWITCH.
STANDBY indicator goes on after 3 sec. Then, unit is ready for exposure.
Press and hold the second stage of EXPOSURE SWITCH. X-RAY indicator illuminates, the buzzer sounds, and x-ray is generated for the time set. The EXPOSURE SWITCH is a DEADMAN style. If the button is released during exposure, exposure is stopped and error lamp will be blinking.
Press and hold the button until exposure is complete.

NOTE: The first stage of EXPOSURE SWITCH is pre-heat of filament.

DON'T KEEP ONLY THE FIRST STAGE OF EXPOSURE SWITCH "ON" LONGER THAN 30 SEC.
If the exposure switch is released during exposure, error light will be blinking.

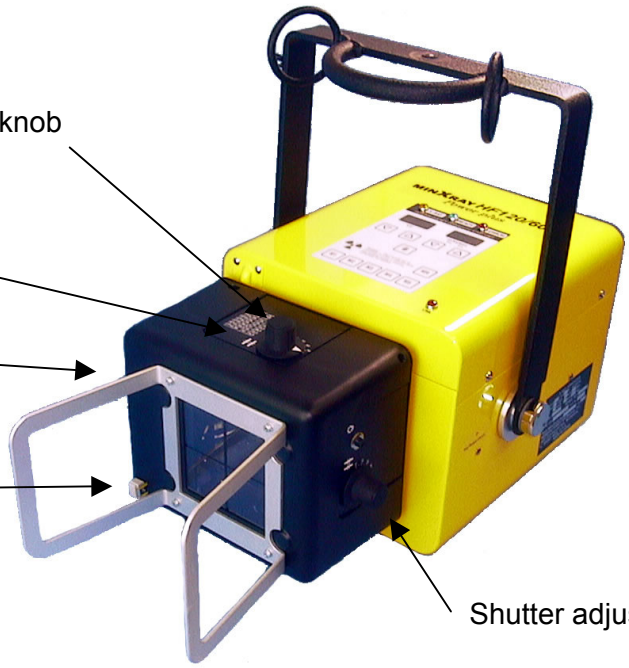
POWER OFF : When the POWER SWITCH is pressed, all indicators on the control panel are off.

ERROR LAMP : *HF120/60H* has 2 kinds of error indications. If either of them is lit, x-ray cannot be generated. Each detail is as follows.

ERROR LAMP	DETAILS	COUNTERMEASURE
Blinking	Exposure switch was released during the X-ray exposure.	Turn off the unit then turn on the unit to reset.
On	Unit malfunction.	Stop procedure and follow steps below.

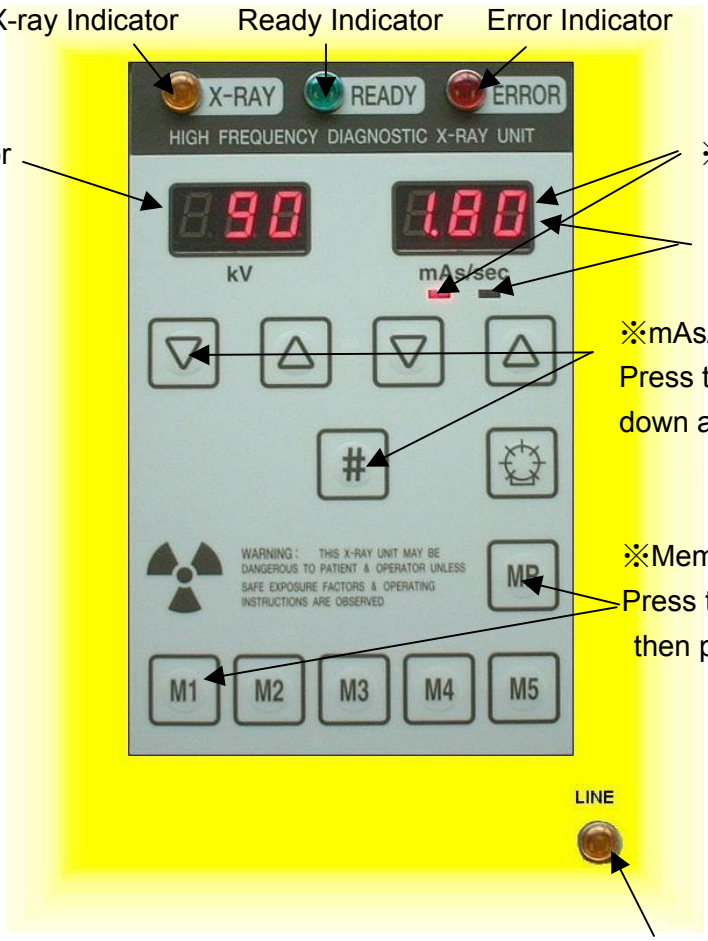
※ If ERROR indicator is lit even when EXPOSURE SWITCH BUTTON is released, it means an unusual situation has occurred. Turn off POWER SWITCH, wait 3 minutes, then start procedures over again. If the error indicator remains lit, refer to P32 of this manual for additional troubleshooting steps.

5.0 Main parts



Exposure switch and cord

Power cord



※mAs Indicator (mAs is ON)

※sec Indicator (sec is ON)

※mAs/sec Display change
Press the shift (#) button then press the down arrow (▽) below the kV display

※Memory write
Press the Memory Storage button (MR) then press memory Recall button (M1)

※ Low line voltage indicator illuminates when line voltage is less than 90V during the X-ray exposure.

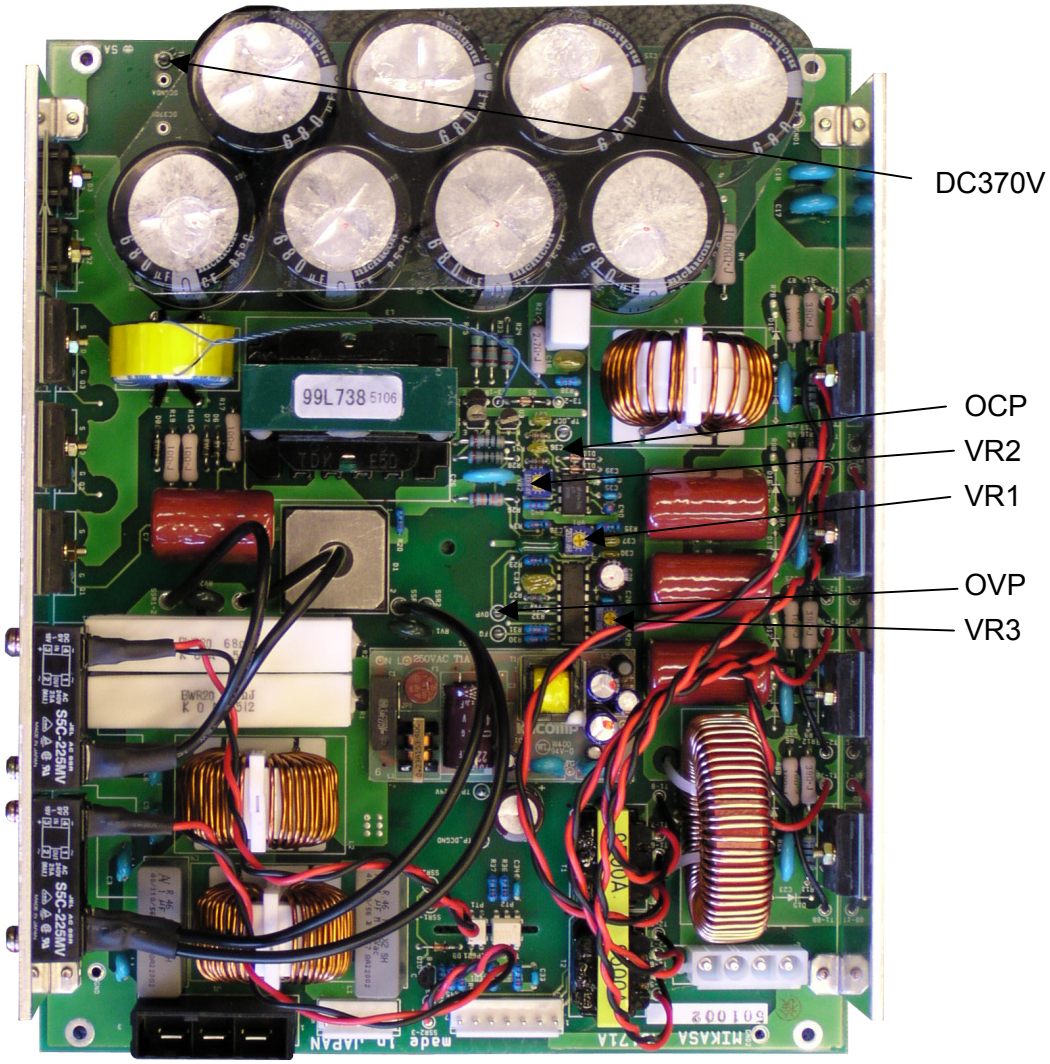
Memory Storage uses two (2) size AA alkaline batteries inside the Battery Compartment, located on the back side of equipment. Open the Battery Compartment using a coin, turning the compartment lid counterclockwise 90°. If there are no batteries in the Battery Compartment, use some adhesive tape to help you remove the compartment lid.

Insert two (2) size AA alkaline batteries in the Battery Compartment, with the + end toward the Battery Compartment lid. Reattach the Battery Compartment lid and lock it with a coin, turning it clockwise 90°.

6.0 Pre-Adjustment

6-1. M9171A PC Board adjustment

※ Each PC Board delivered from the factory has already been adjusted.



This adjustment has to be done after connecting all connectors completely.
Actual x-ray exposure is not necessary.

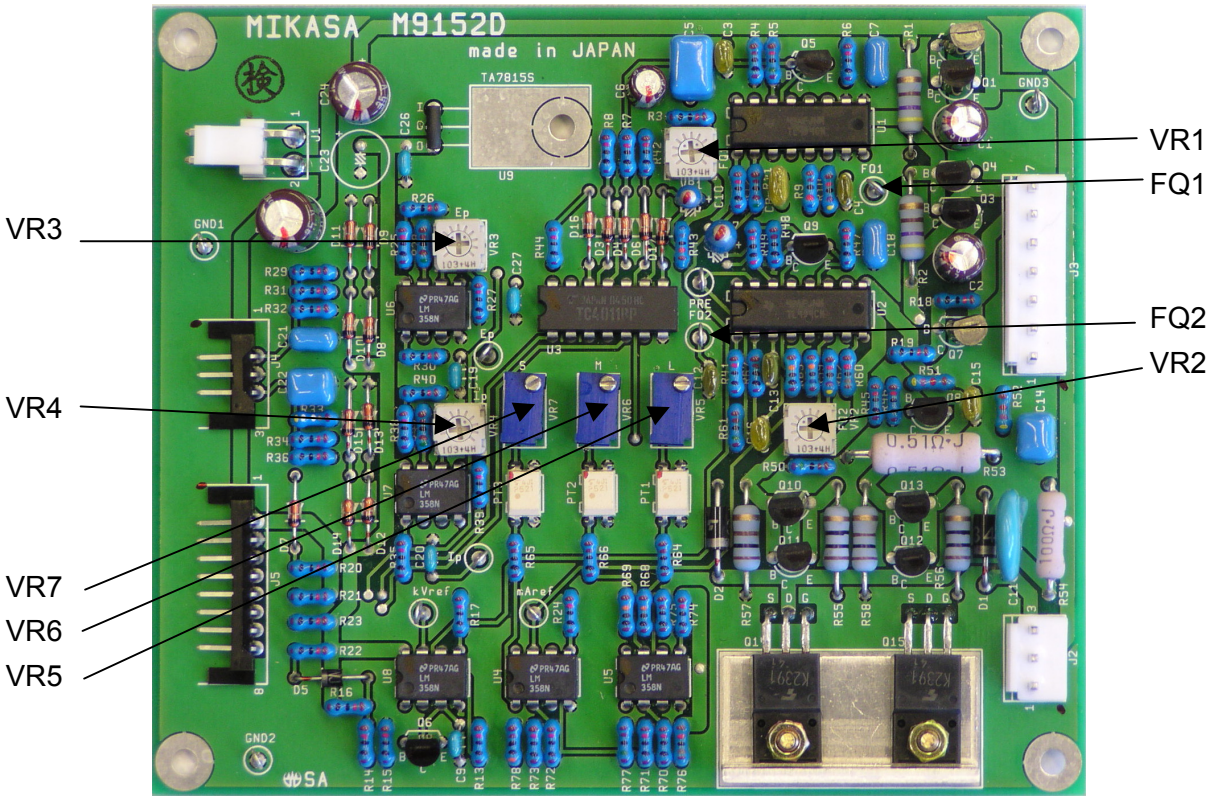
1. Adjustment of VR3 (DC370V)
   Adjust voltage between 370 (+) and GND (–) to be 368.5 – 372 V by turning VR3.
   Turning clockwise increases voltage.

2. Adjustment of VR2 (Over Current Protection circuit)
   Adjust voltage between OCP(+) and GND (–) to be 2.29 – 2.31 V by turning VR2.
   Turning clockwise increases voltage.

3. Adjustment of VR1 (Over Voltage Protection circuit)
   Adjust voltage between OVP (+) and GND (–) to be 1.49 – 1.51 V by turning VR1.
   Turning clockwise decreases voltage.

6-2. M9152D PC Board adjustment

※ Each PC Board delivered from the factory has already been adjusted.



This adjustment has to be done after connecting all connectors completely.
Actual x-ray exposure is not necessary.

1. Adjustment of FQ1
   Adjust frequency between FQ1 (+) and GND (–) to be 80 kHz by turning VR1.
   Turning clockwise increases frequency.

2. Confirmation of FQ2
   Confirm if frequency between FQ2 (+) and GND (–) is 90 kHz by turning VR2.
   Turning clockwise increases frequency.

3. Set VR3 (EP SET) to the center position.

4. Set VR4 (IP SET) to the center position.

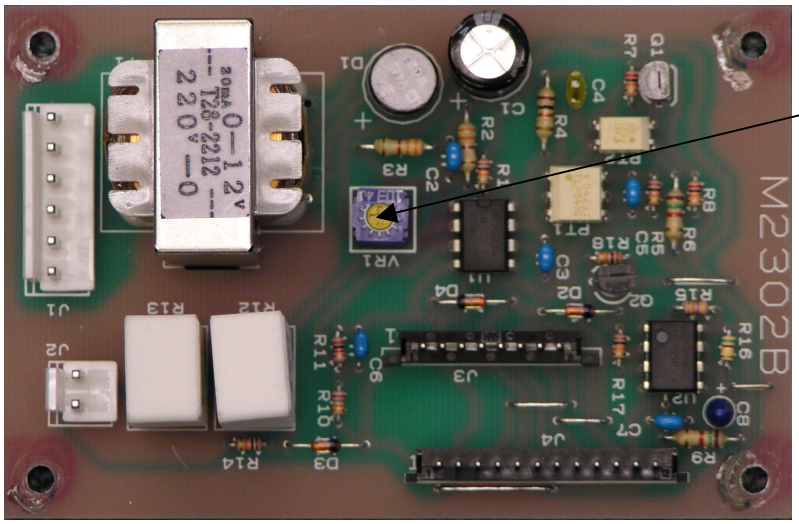
5. Adjustment of VR5 (pre-heat adjustment under 50kV). Turning clockwise increases voltage.
   Adjust voltage between PRE(+) and GND (–) to be 0.629 V by turning VR5

6. Adjustment of VR6(pre-heat adjustment 52 to 80kV) . Turning clockwise increases voltage.
   Adjust voltage between PRE(+) and GND (–) to be 0.569 V by turning VR6

6. Adjustment of VR7 (pre-heat adjustment over 82kV). Turning clockwise increases voltage.
   Adjust voltage between PRE(+) and GND (–) to be 0.541 V by turning VR7

6-3. M2302B PC Board adjustment

※ Each PC Board delivered from the factory has already been adjusted.



This adjustment has to be done after connecting all connectors completely.
Actual x-ray exposure is not necessary.

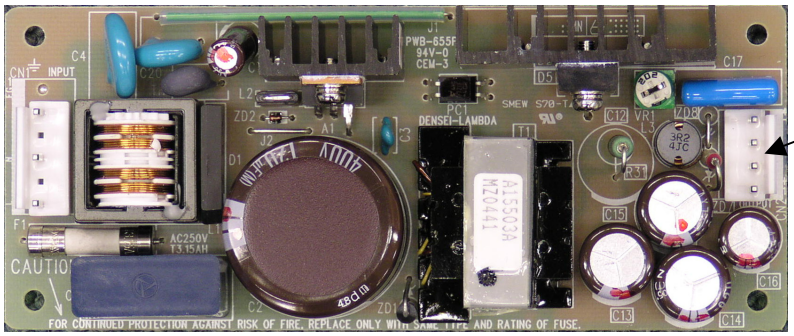
1. Adjustment of Low line voltage indicator.
   1-1. Remove the J3 connector on the M9152D PC board.
   1-2. Adjust the input voltage to 100VAC.
   1-3. Set the power switch to the ON position.
   1-4. Keep pushing exposure switch, and make a adjustment by “VR1” to make Low line voltage indicator is “ON” when the input voltage is lower than 100VAC.

Turning clockwise Turn ON the Low line voltage indicator.

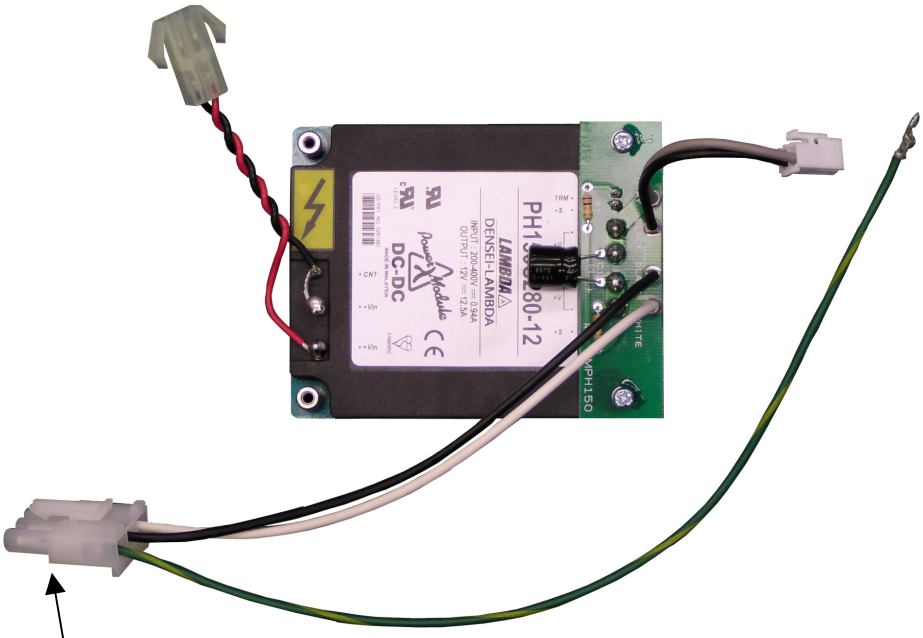
6-4. DC12V power supplys

※ Each PC Board delivered from the factory has already been adjusted.

ZWS30-12



HP150S-280-12



7.0 Re-Adjustment of kV

This adjustment has to be done after connecting all connectors completely.
Actual x-ray exposure is necessary.
This adjustment requires that an exposure be made.
Please observe all radiation related safety precautions.

Confirmation is surely necessary after the re-adjustment of kV.
Direct kV test is necessary using kV test instrument such as the VICTOREEN NERO.

※This adjustment should be done whenever Insert Box or Inverter PC Board (M9171A PCB) is replaced.

Oscilloscope (with storage mode) : Connect CH1 probe to EP, CH2 probe to IP, and GND to GND terminal on M9152D PC Board. (refer page 10)

Setting of oscilloscope: CH1 ; 500m V/div, CH2 ; 500m V/div, 10 msec/div

Setting of x-ray output : 0.2 sec., 80 kV

Place of adjustment : VR3 on M9152D PC Board (EP SET)

Method of adjustment : Measure x-ray tube voltage by oscilloscope and adjust average of peak values of EP waveform to be 1.9 V by VR3.
After the adjustment is finished, set x-ray output to be 120kV and adjust again so that average of peak values of EP waveform to be 2.9 V.

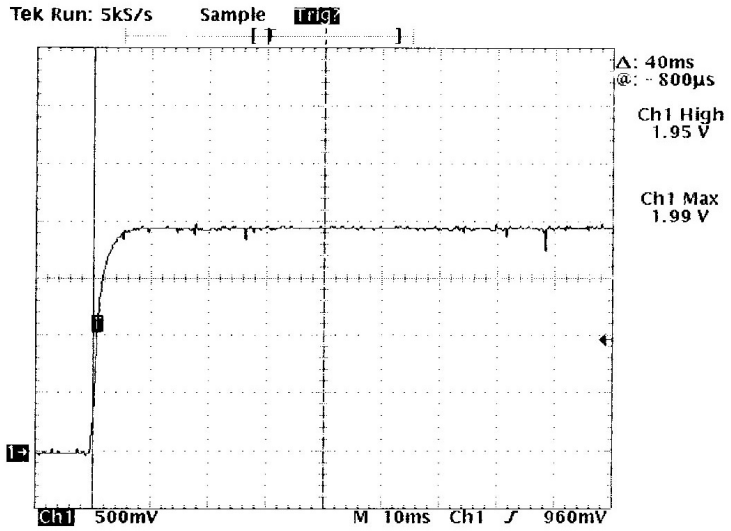
When x-ray tube voltage is measured by non - invasive direct x-ray measuring equipment such as NERO, approx. 3 kV of deviation is included. Therefore, adjust kV to be 97.5 ～ 99 kV at 100 kV station.

It is necessary to measure the actual kV with a direct x-ray measuring Equipment such as NERO for the confirmation after this adjustment.

7-1. Adjustment of 80 kV by VR3

Adjust the ch1 (EP) by VR3 to be 1.9 V ±0.05 V.

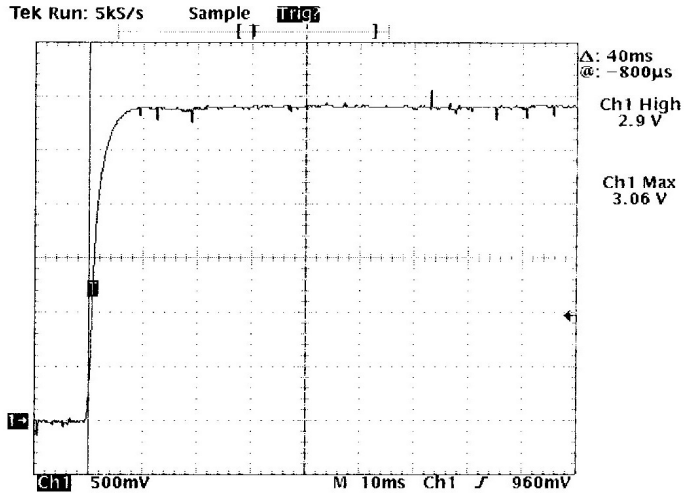
Turning clockwise increases kV.



7-2. Adjustment of 120 kV by VR3

Adjust the ch1 (EP) by VR3 to be 2.9 V ±0.1 V.

Turning clockwise increases kV.



8. 0 Re-Adjustment of mA

This adjustment has to be done after connecting all connectors completely.
Actual x-ray exposure is necessary.
This adjustment requires that an exposure be made.
Please observe all radiation related safety precautions.

※This adjustment should be done whenever Insert Box or Inverter PC Board (M9171A PCB) is replaced.

Oscilloscope (with storage mode) : Connect CH1 probe to EP, CH2 probe to IP, and GND to GND terminal on M9152D PC Board. (refer page 10)

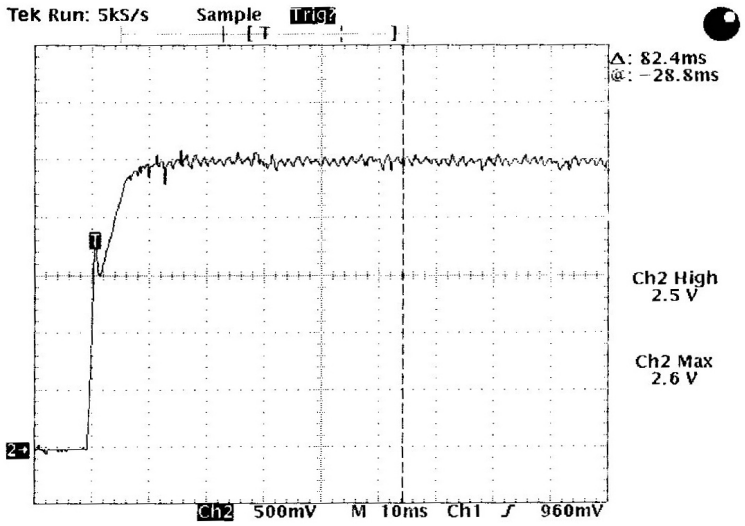
Setting of oscilloscope : CH1 ; 500m V/div, CH2 ; 500m V/div, 10 msec/div

Setting of x-ray output : 0.2 sec., 60 kV

Place of adjustment : VR4 on M9152D PC Board (IP SET)

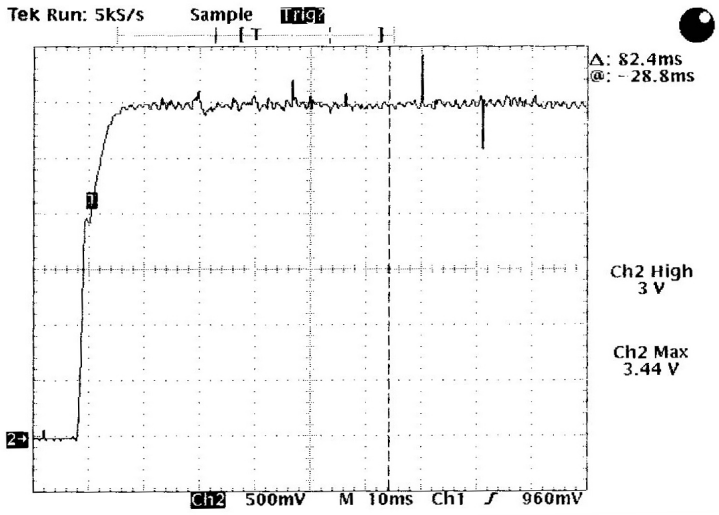
VR4 : adjustment of mA at 60kV.
(mA is increase by turning clockwise.)

8-1.Adjust average of peak values of IP waveform to be 2.5 V by VR4.



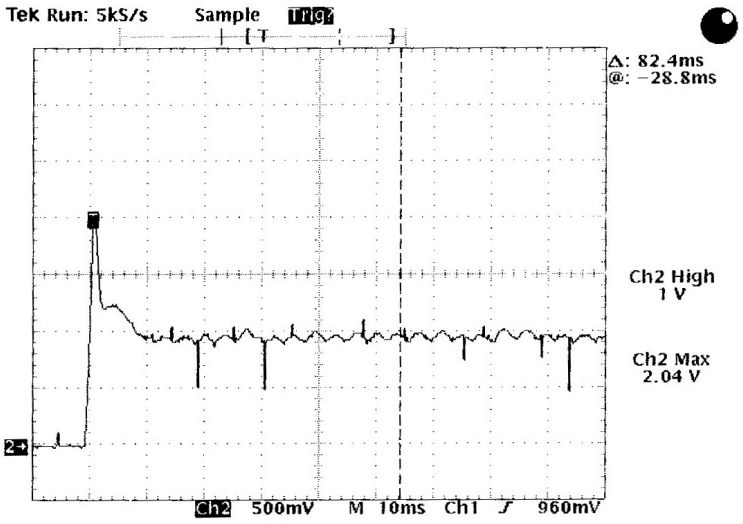
8-2. Adjustment of 60mA at 40kV by VR4

Adjust the ch2 (IP) by VR4 to be 2.9 V ±0.3 V. Turning clockwise increases mA.



8-3. Adjustment of 20mA at 120kV by VR4

Adjust the ch2 (IP) by VR4 to be 0.95 V ±0.1V. Turning clockwise increases mA.



9. 0 Re-Adjustment of Pre-heat value

This adjustment has to be done after connecting all connectors completely.
Actual x-ray exposure is necessary.
This adjustment requires that an exposure be made.
Please observe all radiation related safety precautions.

※This adjustment should be done whenever Insert Box or Inverter PC Board (M9171A PCB) is replaced.

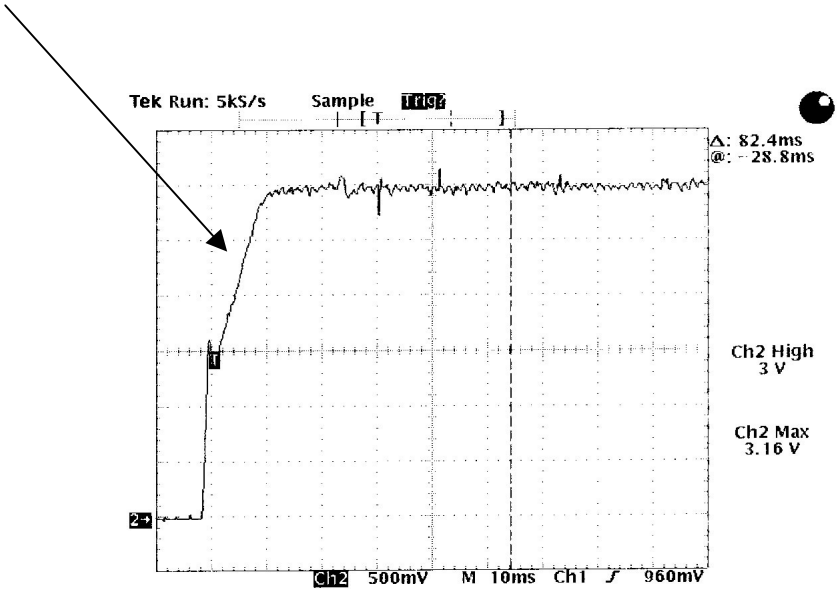
Oscilloscope (with storage mode) : Connect CH1 probe to EP, CH2 probe to IP, and GND to GND terminal on M9152D PC Board. (refer page 10)

Setting of oscilloscope : CH1 ; 500m V/div, CH2 ; 500m V/div, 10 msec/div

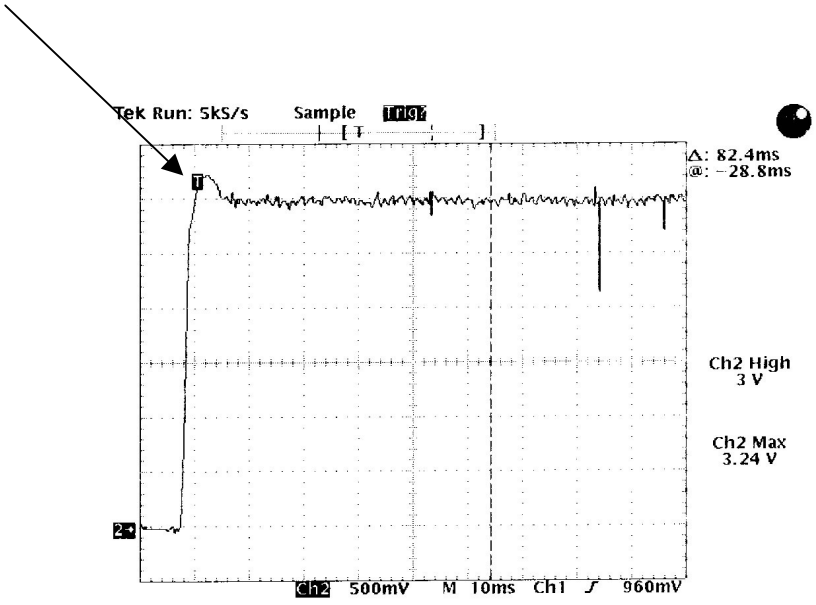
Setting of x-ray output : 0.2 sec., 70 kV

Place of adjustment : VR4 (IP SET)
VR5 (L Pre-heat voltage) ・ 40 to 50kV
VR6 (M Pre-heat voltage) ・ 52 to 80kV
VR7 (S Pre-heat voltage) ・ 82 to 120kV

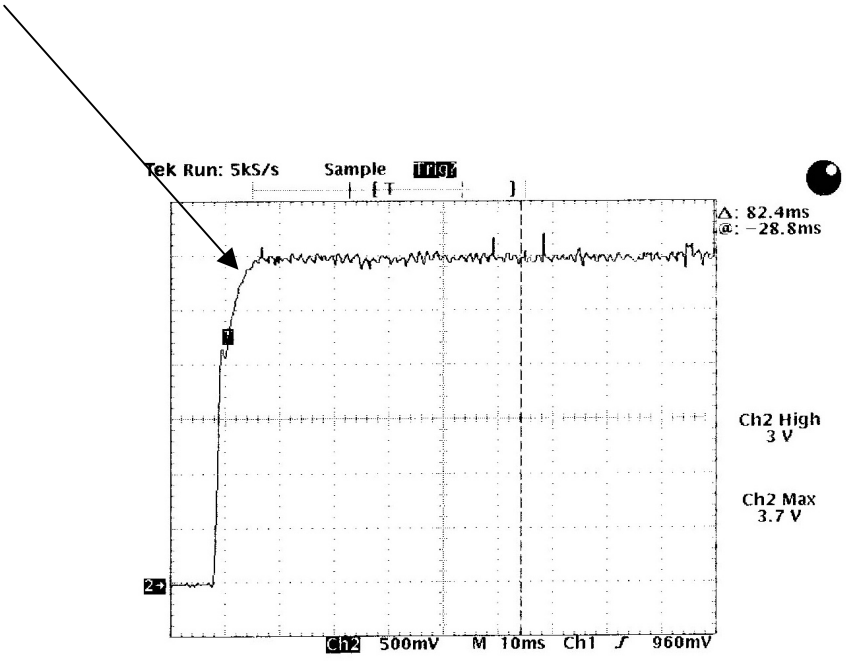
9-1.Adjust peak values of IP waveform to be 3.0 V at 40kV by VR5.
1. Pre-heat value is low. Make Pre-heat value increase by turning VR5 clockwise.



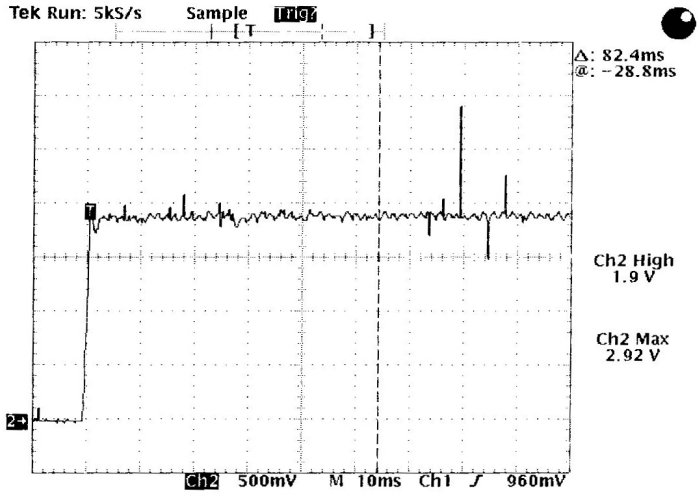
2. Pre-heat value is high. Make Pre-heat value decrease by turning VR5 clockwise.



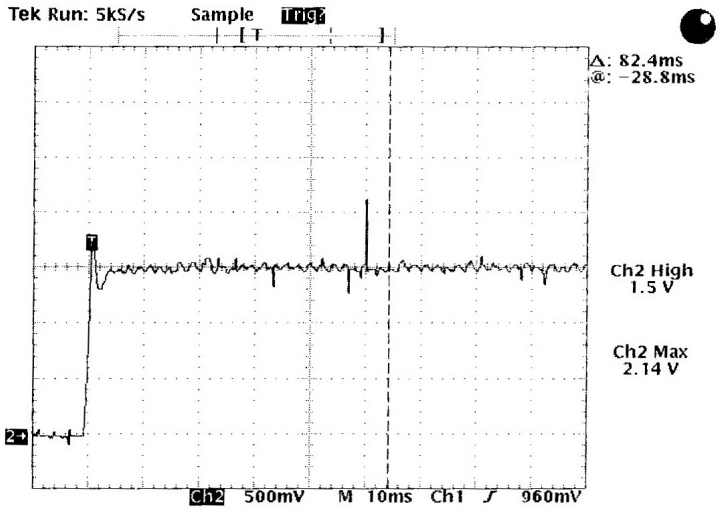
2. Pre-heat value is appropriate.



9-2.Adjust peak values of IP waveform to be 2.0 V at 80kV by VR6.



9-3.Adjust peak values of IP waveform to be 1.5 V at 100kV by VR7.



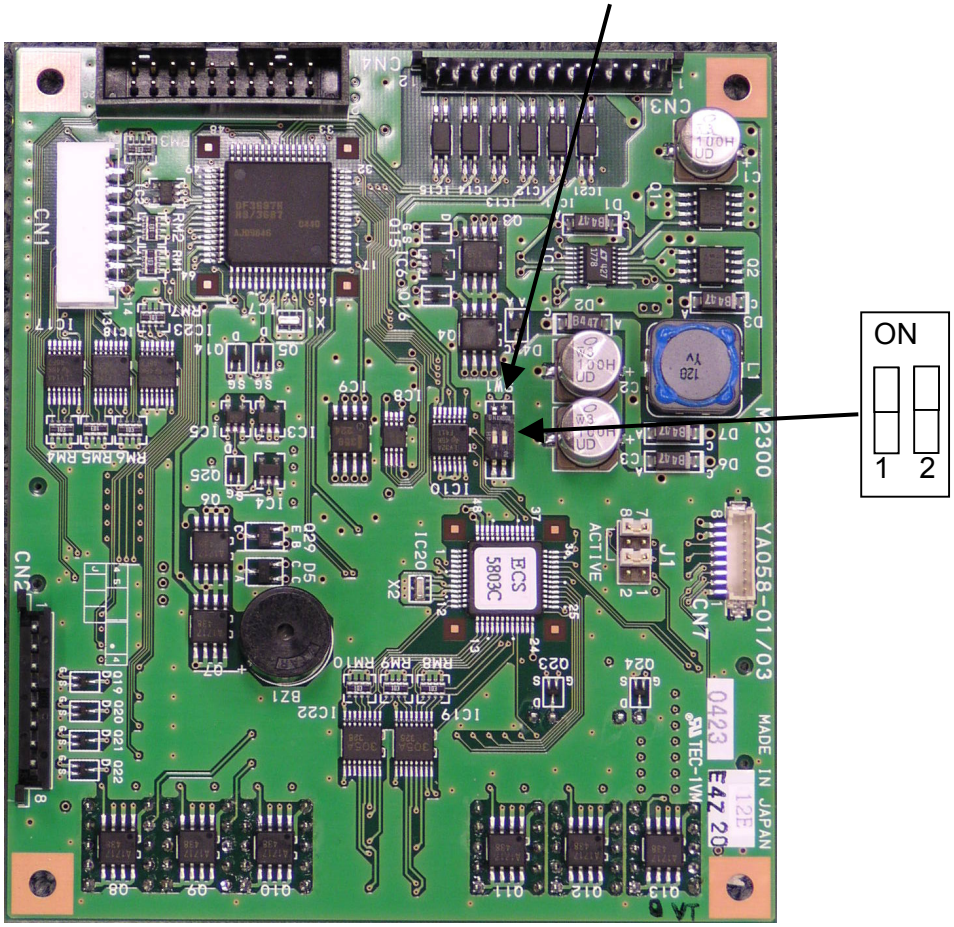
10.0 Re-Adjustment of exposure time

This adjustment has to be done after connecting all connectors completely.
Actual x-ray exposure is necessary.
This adjustment requires that an exposure be made.
Please observe all radiation related safety precautions.

Check the exposure time by using an external exposure time meter such as the VICTOREEN NERO.

The adjustment of the exposure timer is done with a DIPswitch (SW1) on the M2300 board.
When SW1 is turned on, an exposure time gets long 0.002 sec for all settings.

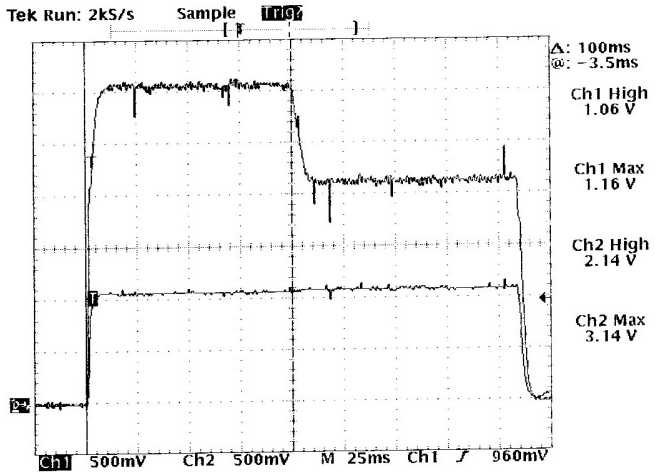
※Remove the battery before you change the setup of DIPswitch.
Turn off a power of unit when you change a DIPswitch.



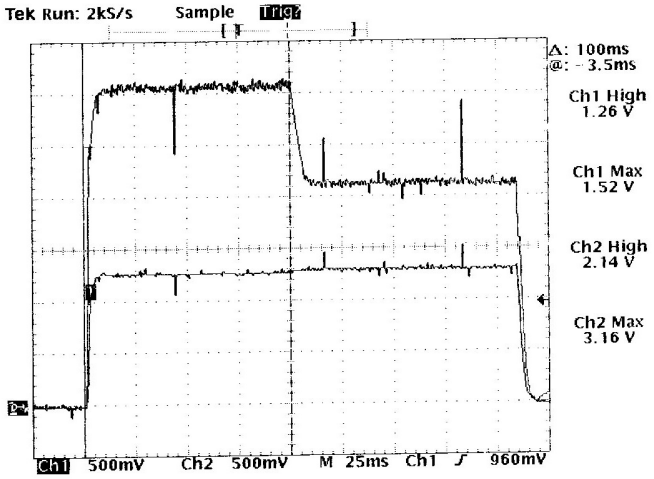
※ DIP switch1 ON = +0.008 sec OFF = +0.006 sec
※ DIP switch2 is not used. ALL TIME OFF position

11.0 Sample of Output waveform

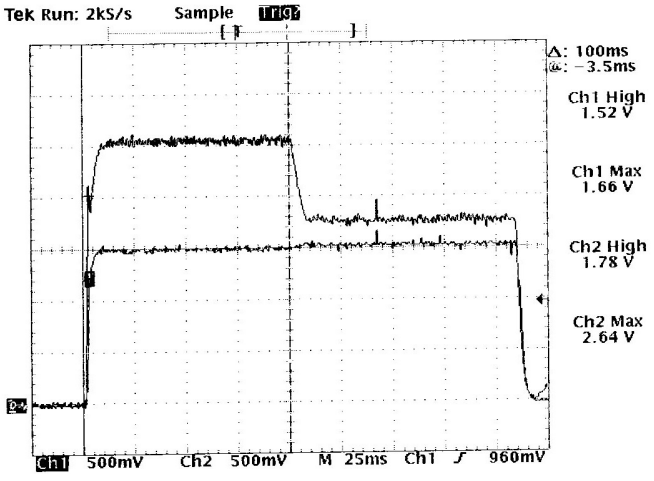
Normal waveform



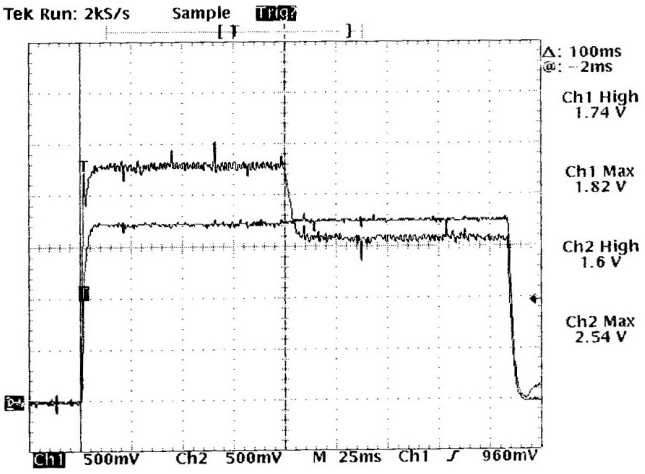
40kV・60mA/42mA



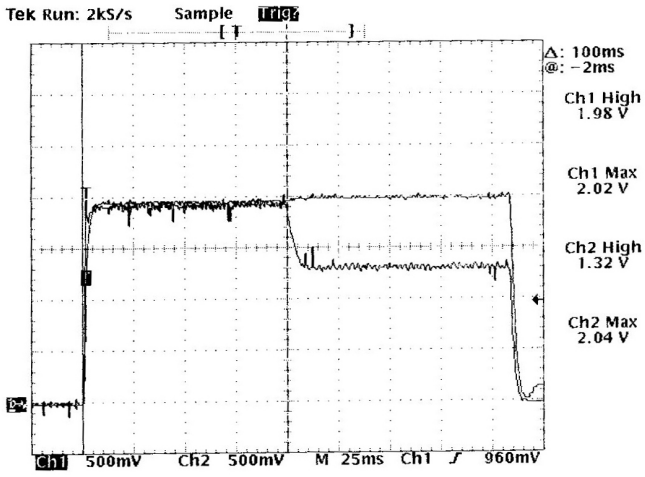
50kV・60mA/42mA



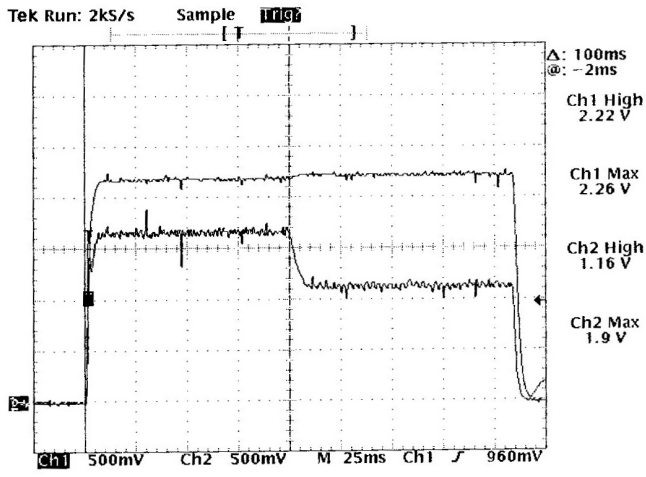
60kV・50mA/35mA



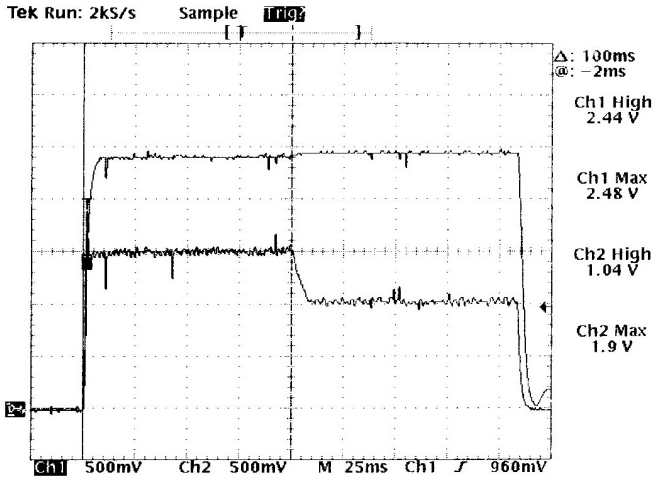
70kV・45mA/31.5mA



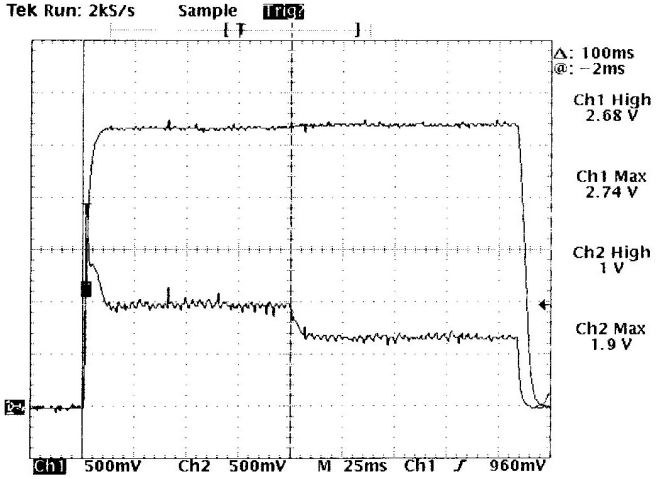
80kV・33mA/23.1mA



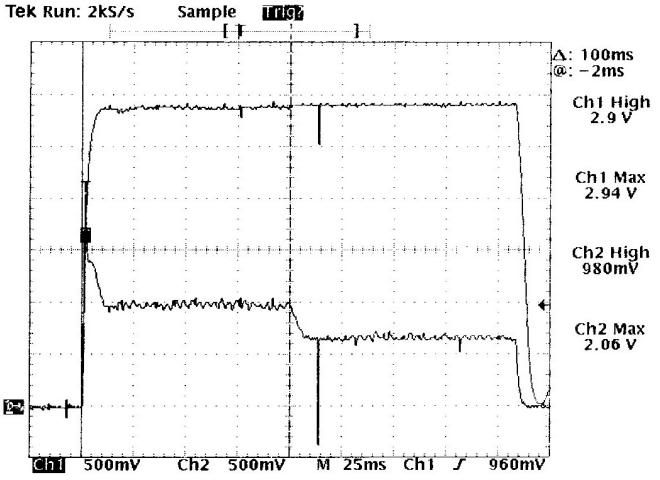
90・33mA/23.1mA



100kV・30mA/21mA



110kV・20mA/14mA



120kV・20mA/14mA

12.0 Measure mA by mA jack output

mA Jack (Single round phone jack, 3.5 mm diameter) connection diagram

1. Close the collimator shutters fully.

2. Connect voltage measurement equipment (ex. Osilloscope) with mA jack (Single round phone jack, 3.5mm/dm) to socket on the back of the *HF120/60H*.

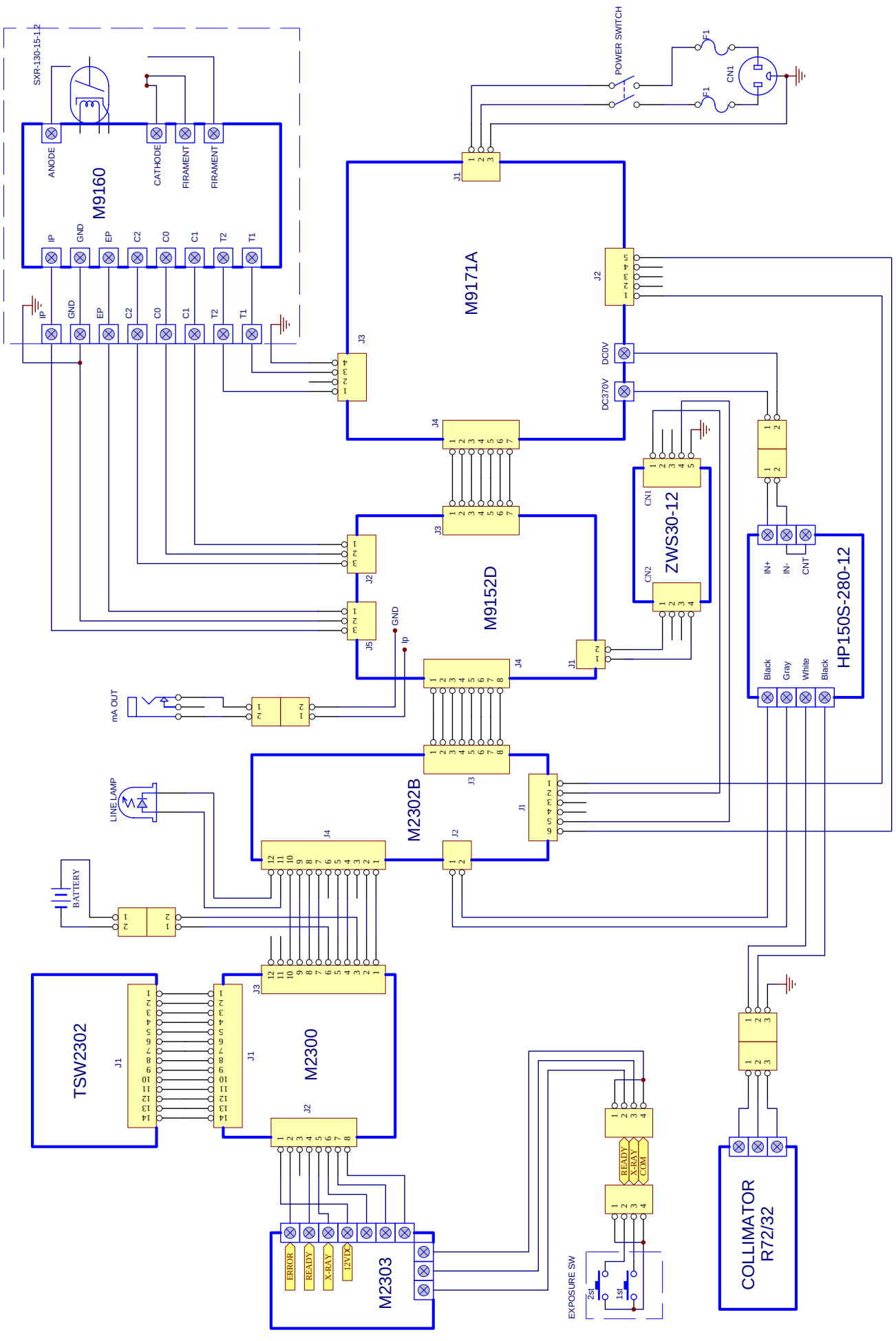
3. Make exposure.

4. Measure voltage of mA Jack ‘s output. (Single round phone jack, 3.5 mm/dm)

5. Calculate the mA as follows : 20 mA=1.0 V

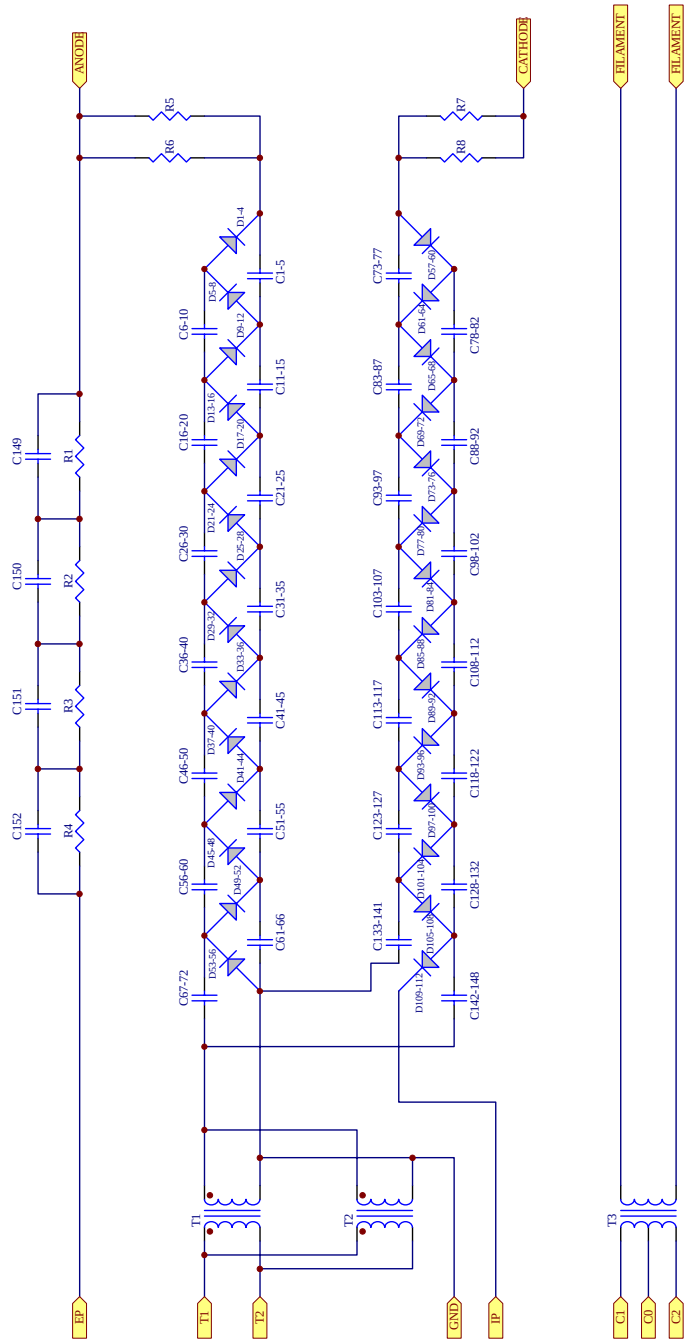
This measurement requires that an exposure be made.
During the measurement, close the collimator shutters fully to block the primary X-ray.
Only voltage value can be measured from mA jack output.
mA jack ‘s output just can be measured only during x-ray exposure.

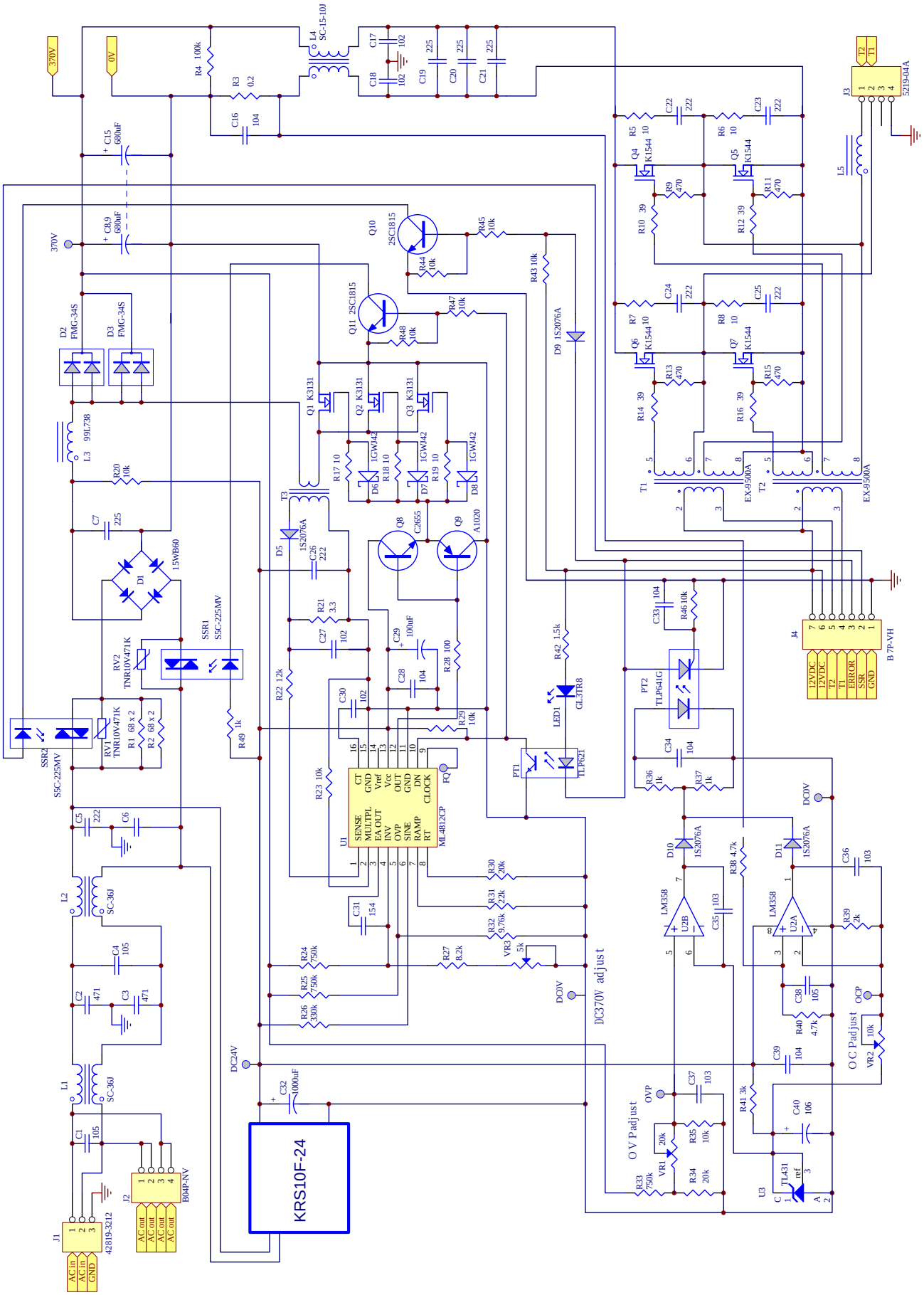
13.0 Wiring diagram

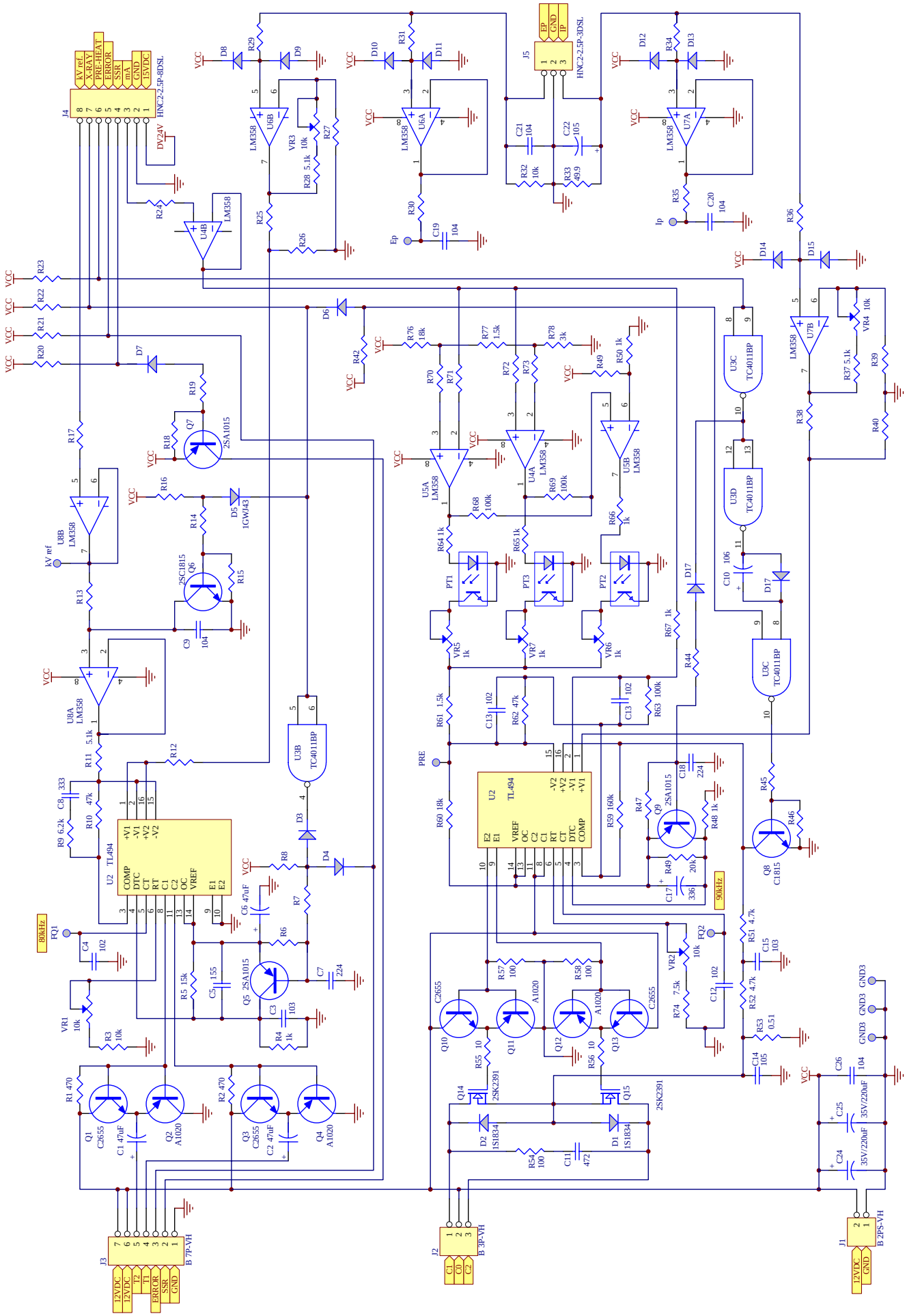


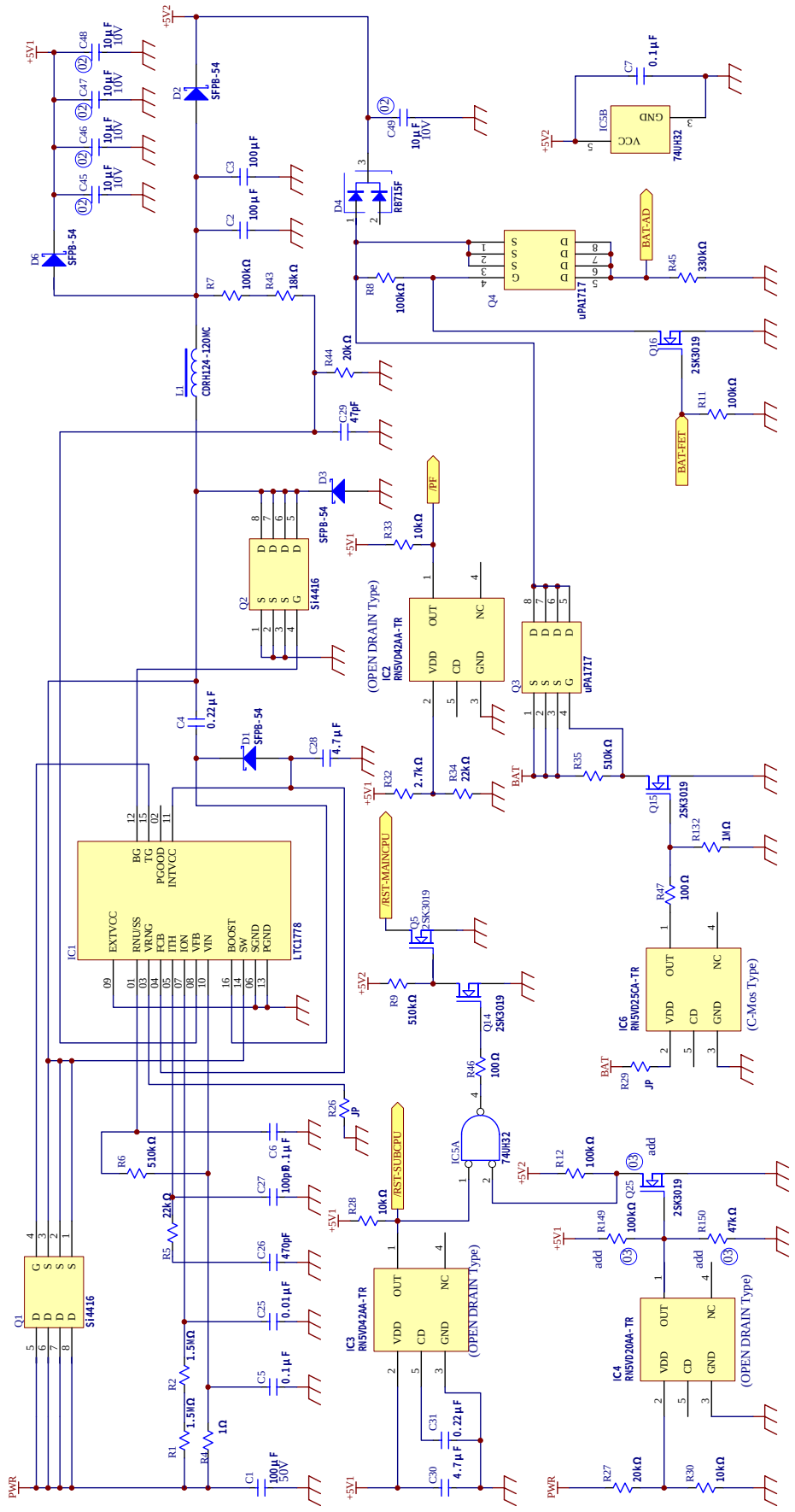
14.0 Schematic diagram

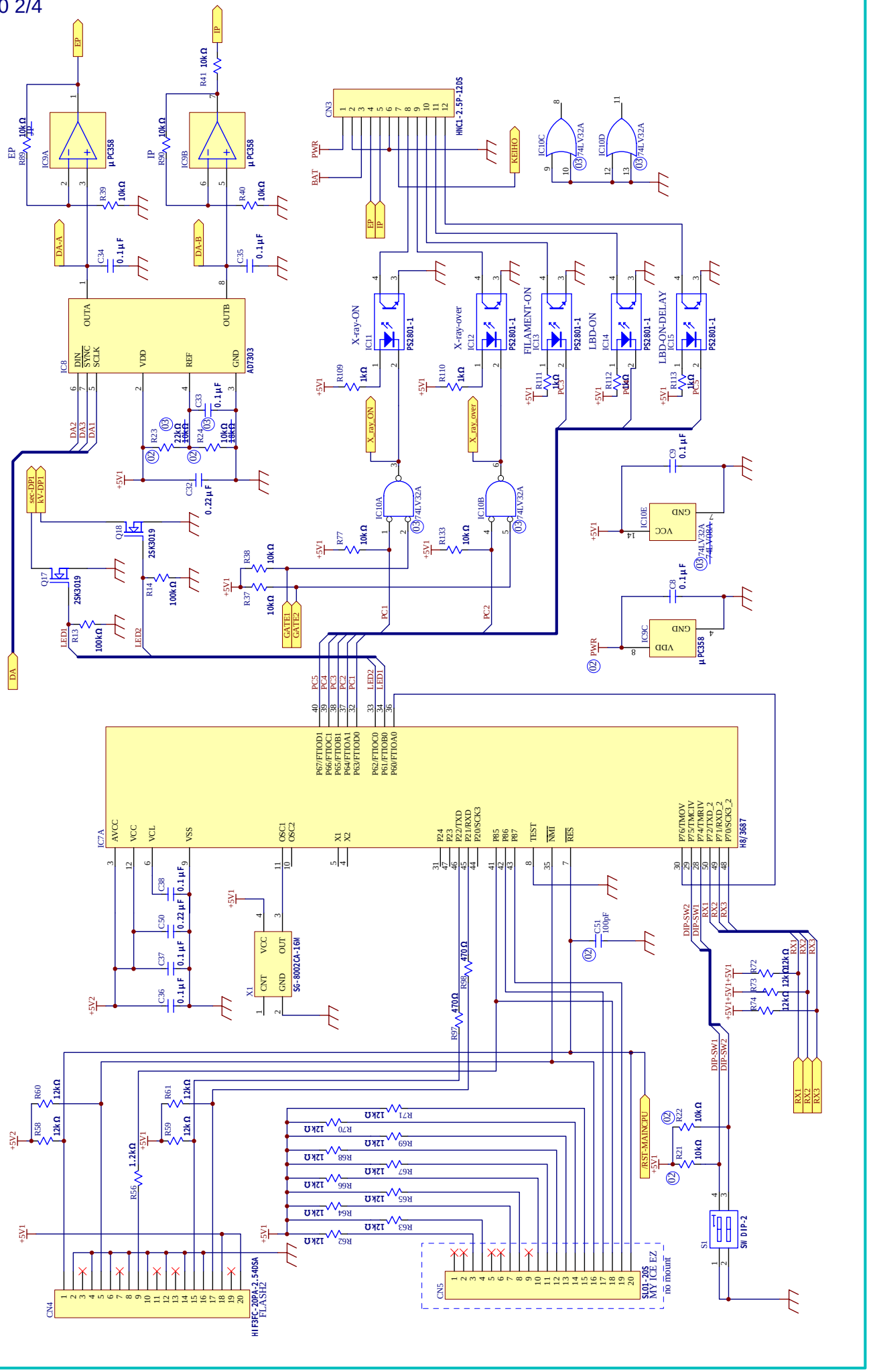
M9160

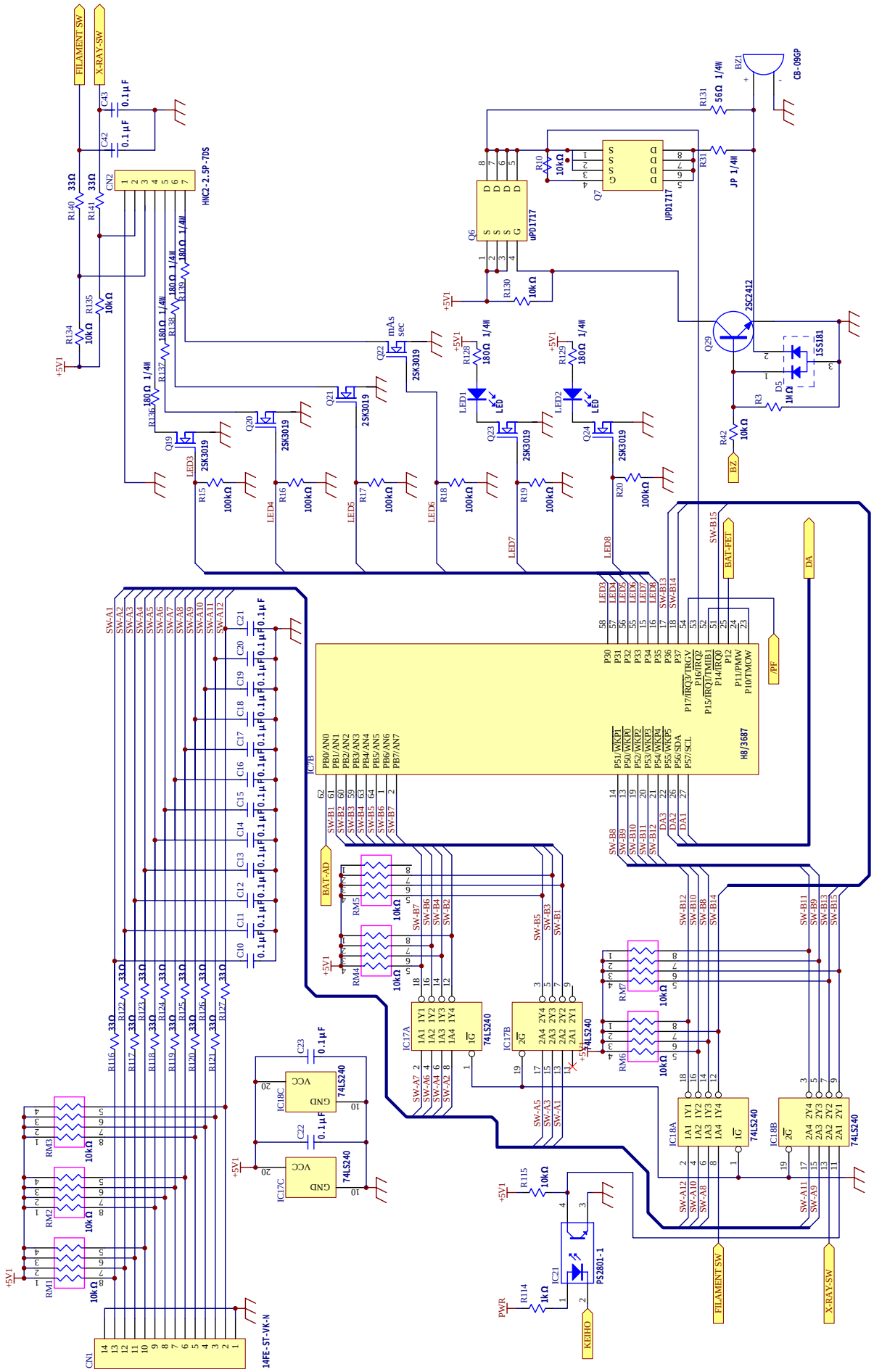


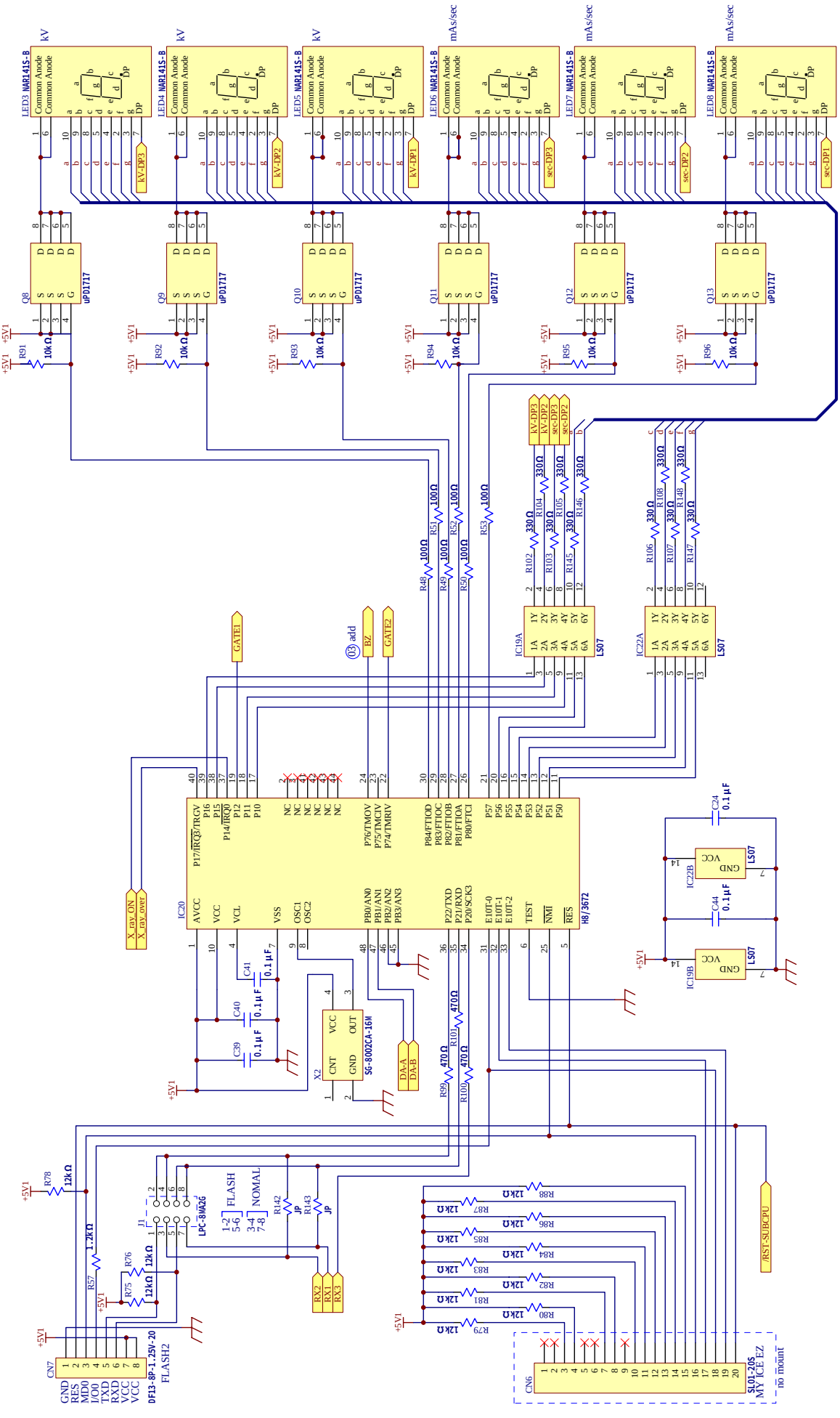

KRS10F-24
DC370V adjust
OVP
OCP
OV Padjust
OC Padjust
370V
0V
DC24V
DC0V
U1 ML4812CP
U2A LM358
U2B LM358
U3 TL431
T1 EX-9500A
T2 EX-9500A
J1 42819-3212
J2 B04P-NV
J3 5219-04A
J4 B 7P-VH

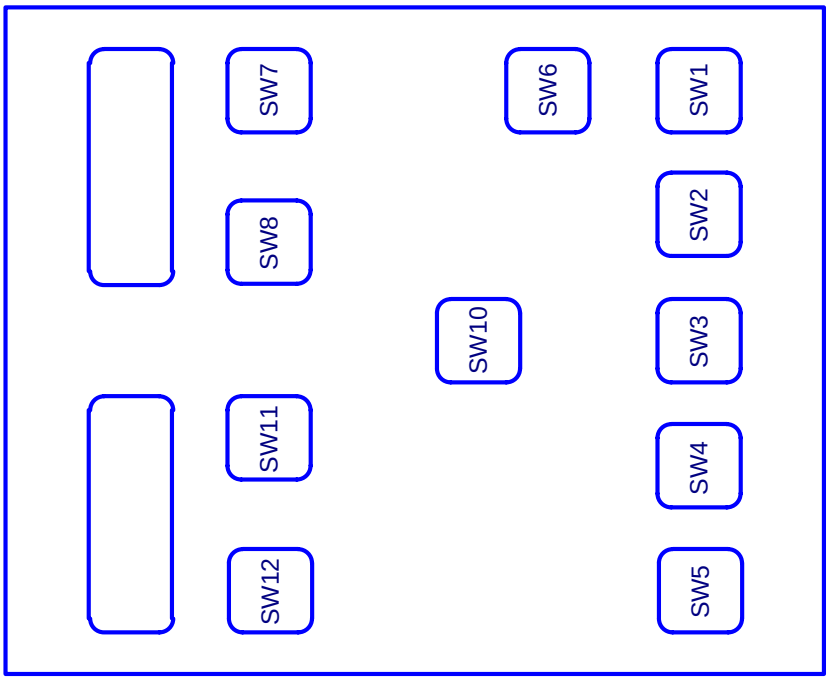

J4
KV ref.
X-RAY
PRE-HEAT
ERROR
SSR
mA
GND
15VDC
HNC2-2.5P-8DSL
DV24V
J5
EP
GND
IP
HNC2-2.5P-3DSL
VCC
LM358
U6B
U6A
U7A
U4B
VR3
10k
R27
R28 5.1k
R25
R26
R29
R30
R31
R32 10k
R33 49.9
C21 104
C22 105
C19 104
C20 104
R34
R35
R36
Ep
Ip
D8
D9
D10
D11
D12
D13
D14
D15
U3C
U3D
U3B
TC4011BP
U7B
VR4 10k
R37 5.1k
R38
R39
R40
C10 106
D17
R67 1k
R44
U5A
U5B
U4A
R68 100k
R69 100k
R70
R71
R72
R73
R76 18k
R77 1.5k
R78 3k
R49
R50 1k
R66 1k
R64 1k
R65 1k
PT1
PT3
PT2
VR5 1k
VR7 1k
VR6 1k
R42
D6
D7
R19
R18
Q7
2SA1015
R17
R16
D5
1GW43
R14
Q6
2SC1815
R15
C9 104
kV ref
U8B
U8A
R13
R12
R11 5.1k
C8 333
R10 47k
R9 6.2k
U2
TL494
COMP
DTC
CT
RT
C1
C2
OC
VREF
E1
E2
-V1
-V2
+V1
+V2
PRE
R60 18k
R61 1.5k
C13 102
R62 47k
R63 100k
R59 160k
C18 224
R47
Q9
2SA1015
R48 1k
C17 336
R49 20k
90kHz
R45
R46
Q8
C1815
FQ1
80kHz
C4 102
VR1 10k
R3 10k
R5 15k
C5 155
Q5
2SA1015
C3
103
R4 1k
C6 47uF
R6
R7
R8
D3
D4
C7 224
FQ2
VR2 10k
R74 7.5k
C12 102
R51 4.7k
R52 4.7k
R53 0.51
C15 103
C14 105
R1 470
R2 470
Q1
C2655
C1 47uF
Q2
A1020
Q3
C2655
C2 47uF
Q4
A1020
R57 100
R58 100
Q10
Q11
Q12
Q13
R55 10
R56 10
Q14
Q15
2SK2391
D2
1S1834
D1
1S1834
R54 100
C11 472
C26 104
C25
C24
35V/220uF
J3
7P-VH
12VDC
12VDC
T2
T1
ERROR
SSR
GND
J2
3P-VH
C1
C0
C2
J1
2PS-VH
12VDC
GND
GND3

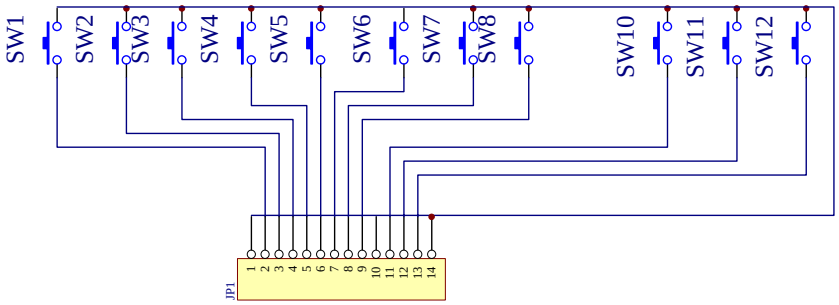

+5V1
+5V2
C48 10µF 10V
C47 10µF 10V
C46 10µF 10V
C45 10µF 10V
D6 SFPB-54
D2 SFPB-54
C3 100µF
C2 100µF
R7 100kΩ
R43 18kΩ
L1 CDRH124-120NC
C49 10µF 10V
D4 RB715F
C7 0.1µF
IC5B 74UH32
BAT-AD
R45 330kΩ
Q4 uPA1717
R8 100kΩ
Q16 2SK3019
R11 100kΩ
BAT-FET
R44 20kΩ
C29 47pF
D3 SFPB-54
/PF
R33 10kΩ
Q2 Si4416
IC2 RN5VD42AA-TR (OPEN DRAIN Type)
Q3 uPA1717
C4 0.22µF
D1 SFPB-54
C28 4.7µF
R32 2.7kΩ
R34 22kΩ
R35 510kΩ
Q15 2SK3019
R132 1MΩ
IC1 LTC1778
EXTVCC RNU/SS VRNG PCB ITH ION VFB VIN BOOST SW SGND PGND BG TG PGOOD INTVCC
/RST-MAINCPU
Q5 2SK3019
R47 100Ω
IC6 RN5V025CA-TR (C-Mos Type)
R9 510kΩ
Q14 2SK3019
R46 100Ω
R29 JP
R26 JP
R6 510kΩ
C6 100pF 0.1µF
IC5A 74UH32
/RST-SUBCPU
R12 100kΩ
Q25 2SK3019
R28 10kΩ
C27
R5 22kΩ
C26 470pF
C25 0.01µF
C5 0.1µF
R2 1.5MΩ
R1 1.5MΩ
R4 1Ω
C1 100µF 50V
Q1 Si4416
IC3 RN5VD42AA-TR (OPEN DRAIN Type)
C31 0.22µF
C30 4.7µF
R149 100kΩ
R150 47kΩ
IC4 RN5V020AA-TR (OPEN DRAIN Type)
R27 20kΩ
R30 10kΩ
PWR
BAT
add

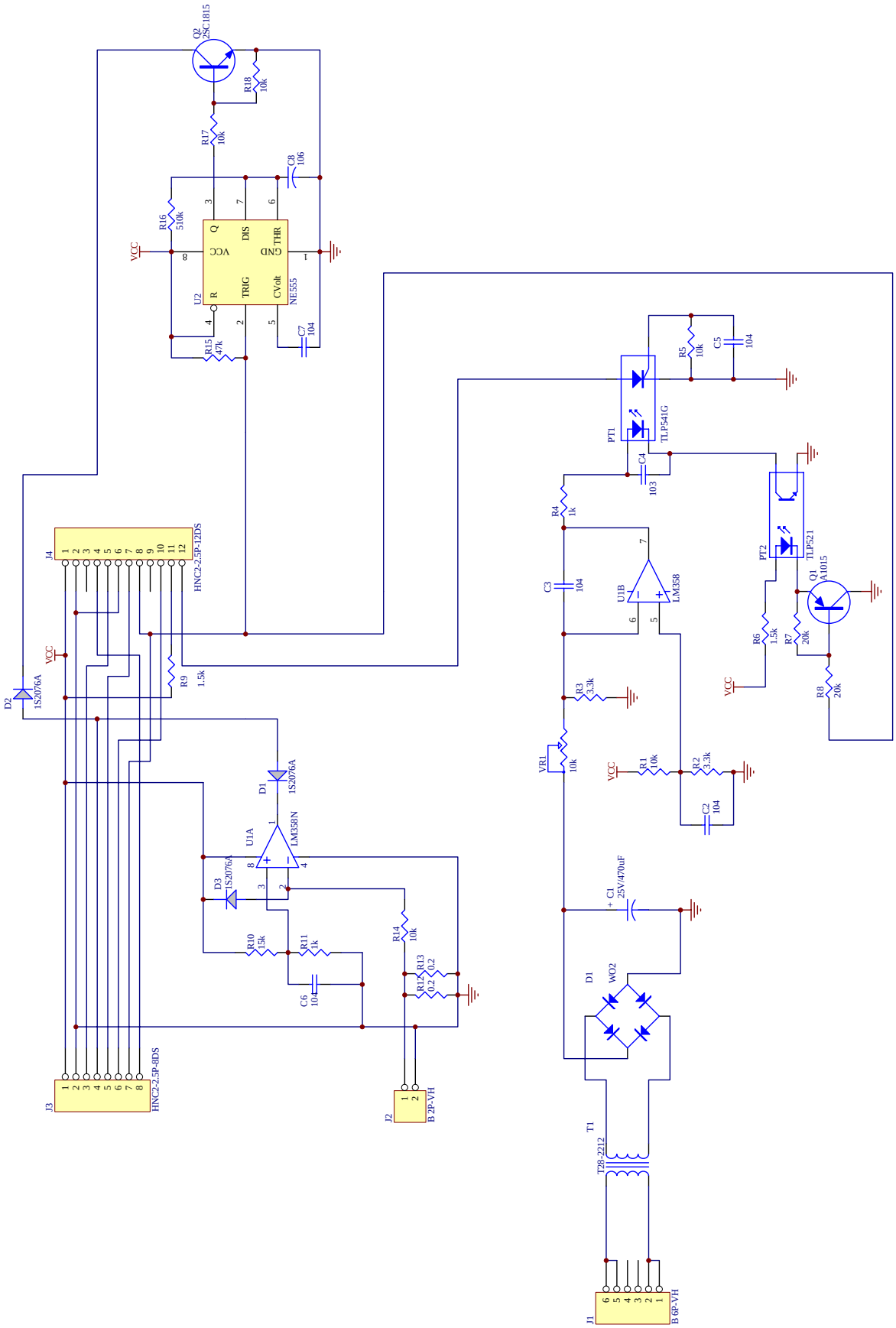

EP
IP
IC9A
IC9B
μPC358
R89 10kΩ
R90 10kΩ
R41 10kΩ
R39 10kΩ
R40 10kΩ
DA-A
DA-B
C34 0.1μF
C35 0.1μF
IC8
AD7303
OUTA
OUTB
DIN
SYNC
SCLK
VDD
REF
GND
DA1
DA2
DA3
R23 22kΩ
R24 10kΩ
C33 0.1μF
C32 0.22μF
+5V1
DA
sec-DP1
kV-DP1
Q18 2SK3019
Q17 2SK3019
R14 100kΩ
R13 100kΩ
LED1
LED2
R38 10kΩ
R37 10kΩ
GATE1
GATE2
CN3
HNC1-2.5P-12DS
PWR
BAT
KEIHO
EP
IP
IC10C
IC10D
74LV32A
X-ray-ON
X-ray-over
FILAMENT-ON
LBD-ON
LBD-ON-DELAY
IC11
IC12
IC13
IC14
IC15
PS2801-1
R109 1kΩ
R110 1kΩ
R111 1kΩ
R112 1kΩ
R113 1kΩ
X_ray_ON
X_ray_over
IC10A
IC10B
R77 10kΩ
R133 10kΩ
PC1
PC2
PC3
PC4
PC5
IC10E
IC9C
C9 0.1μF
C8 0.1μF
IC7A
H8/3687
AVCC
VCC
VCL
VSS
OSC1
OSC2
X1
X2
TEST
NMI
RES
C38 0.1μF
C50 0.22μF
C37 0.1μF
C36 0.1μF
C51 100pF
X1
SG-8002CA-16M
R97 470Ω
R98 470Ω
DIP-SW1
DIP-SW2
RX1
RX2
RX3
R72 12kΩ
R73 12kΩ
R74 12kΩ
R58 12kΩ
R60 12kΩ
R59 12kΩ
R61 12kΩ
R56 1.2kΩ
R62 12kΩ
R63 12kΩ
R64 12kΩ
R65 12kΩ
R66 12kΩ
R67 12kΩ
R69 12kΩ
R70 12kΩ
R71 12kΩ
RST-MAINCPU
R22 10kΩ
R21 10kΩ
S1
SW DIP-2
CN4
HIF3FC-20PA-2.54DSA
FLASH2
CN5
5101-20S
MYTCE EZ
no mount


FILAMENT SW
X-RAY-SW
CN2
HNC2-2.5P-7DS
R140 33Ω
R141 33Ω
C43 0.1μF
C42 0.1μF
R134 10kΩ
R135 10kΩ
+5V1
R136 180Ω 1/4W
R137 180Ω 1/4W
R138 180Ω 1/4W
R139 180Ω 1/4W
Q19 2SK3019
Q20 2SK3019
Q21 2SK3019
Q22 2SK3019
Q23 2SK3019
Q24 2SK3019
LED1
LED2
LED3
LED4
LED5
LED6
LED7
LED8
R15 100kΩ
R16 100kΩ
R17 100kΩ
R18 100kΩ
R19 100kΩ
R20 100kΩ
R126 180Ω 1/4W
R129 180Ω 1/4W
R130 10kΩ
Q6 uPD1717
Q7 UPD1717
R10 10kΩ
R131 56Ω 1/4W
BZ1 CB-096P
R31 JP 1/4W
Q29 2SC2412
1SS181
D5
R3 1MΩ
R42 10kΩ
BZ
BAT-FET
DA
/PF
IC7B H8/3687
SW-A1
SW-A2
SW-A3
SW-A4
SW-A5
SW-A6
SW-A7
SW-A8
SW-A9
SW-A10
SW-A11
SW-A12
SW-B1
SW-B2
SW-B3
SW-B4
SW-B5
SW-B6
SW-B7
SW-B8
SW-B9
SW-B10
SW-B11
SW-B12
SW-B13
SW-B14
SW-B15
BAT-AD
C10 0.1μF
C11 0.1μF
C12 0.1μF
C13 0.1μF
C14 0.1μF
C15 0.1μF
C16 0.1μF
C17 0.1μF
C18 0.1μF
C19 0.1μF
C20 0.1μF
C21 0.1μF
R116 33Ω
R117 33Ω
R118 33Ω
R119 33Ω
R120 33Ω
R121 33Ω
R122 33Ω
R123 33Ω
R124 33Ω
R125 33Ω
R126 33Ω
R127 33Ω
RM1 10kΩ
RM2 10kΩ
RM3 10kΩ
RM4 10kΩ
RM5 10kΩ
RM6 10kΩ
RM7 10kΩ
IC17A 74LS240
IC17B 74LS240
IC17C 74LS240
IC18A 74LS240
IC18B 74LS240
IC18C 74LS240
C22 0.1μF
C23 0.1μF
CN1 14FE-ST-VK-N
R115 10kΩ
R114 1kΩ
IC21 PS2801-1
PWR
KEIHO
FILAMENT SW
X-RAY-SW


LED3 NAR1415-B
LED4 NAR1415-B
LED5 NAR1415-B
LED6 NAR1415-B
LED7 NAR1415-B
LED8 NAR1415-B
Common Anode
kV
mAs/sec
kV-DP3
kV-DP2
kV-DP1
sec-DP3
sec-DP2
sec-DP1
Q8
Q9
Q10
Q11
Q12
Q13
uPD1717
+5V1
R91
R92
R93
R94
R95
R96
10kΩ
R48
R49
R50
R51
R52
R53
100Ω
R102
R103
R104
R105
R145
R146
R106
R107
R108
R147
R148
330Ω
IC19A
IC22A
LS07
GATE1
GATE2
BZ
add
IC20
H8/3672
X_ray_ON
X_ray_over
C41
C40
C39
0.1μF
C24
C44
IC22B
IC19B
X2
S6-8002CA-16M
DA-A
DA-B
R99
R100
R101
470Ω
R78
12kΩ
1.2kΩ
R57
R75
R76
R142
R143
JP
J1
LPC-8MA26
FLASH
NOMAL
1-2
5-6
3-4
7-8
RX2
RX1
RX3
R79
R80
R81
R82
R83
R84
R85
R86
R87
R88
12kΩ
/RST-SUBCPU
CN7
DF13-8P-1.25V-20
FLASH2
GND
RES
MD0
I/O0
TXD
RXD
VCC
CN6
SL01-20S
MY ICE EZ
no mount

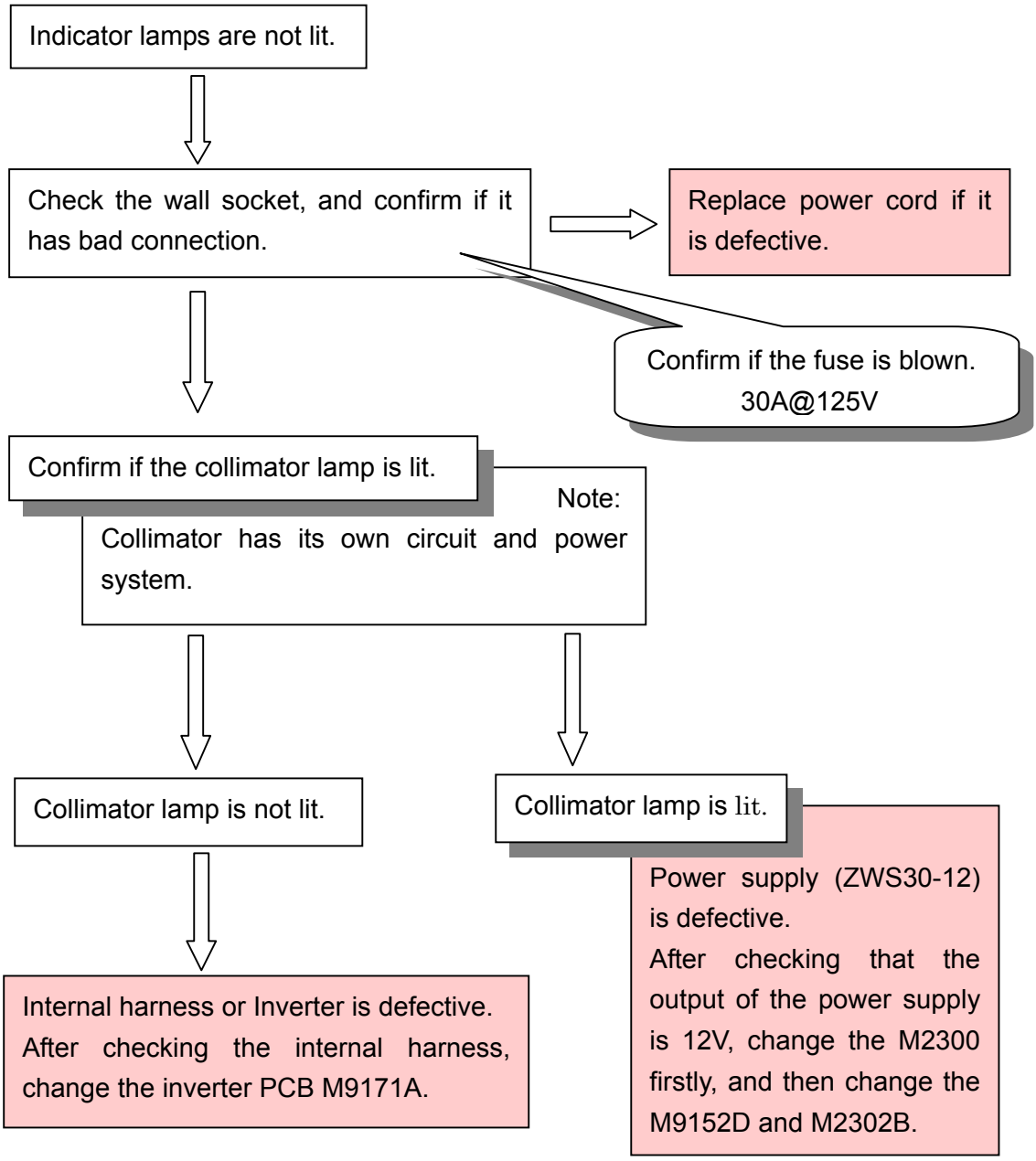

SW7
SW6
SW1
SW8
SW2
SW10
SW3
SW11
SW4
SW12
SW5


SW1
SW2
SW3
SW4
SW5
SW6
SW7
SW8
SW10
SW11
SW12
JP1
1
2
3
4
5
6
7
8
9
10
11
12
13
14

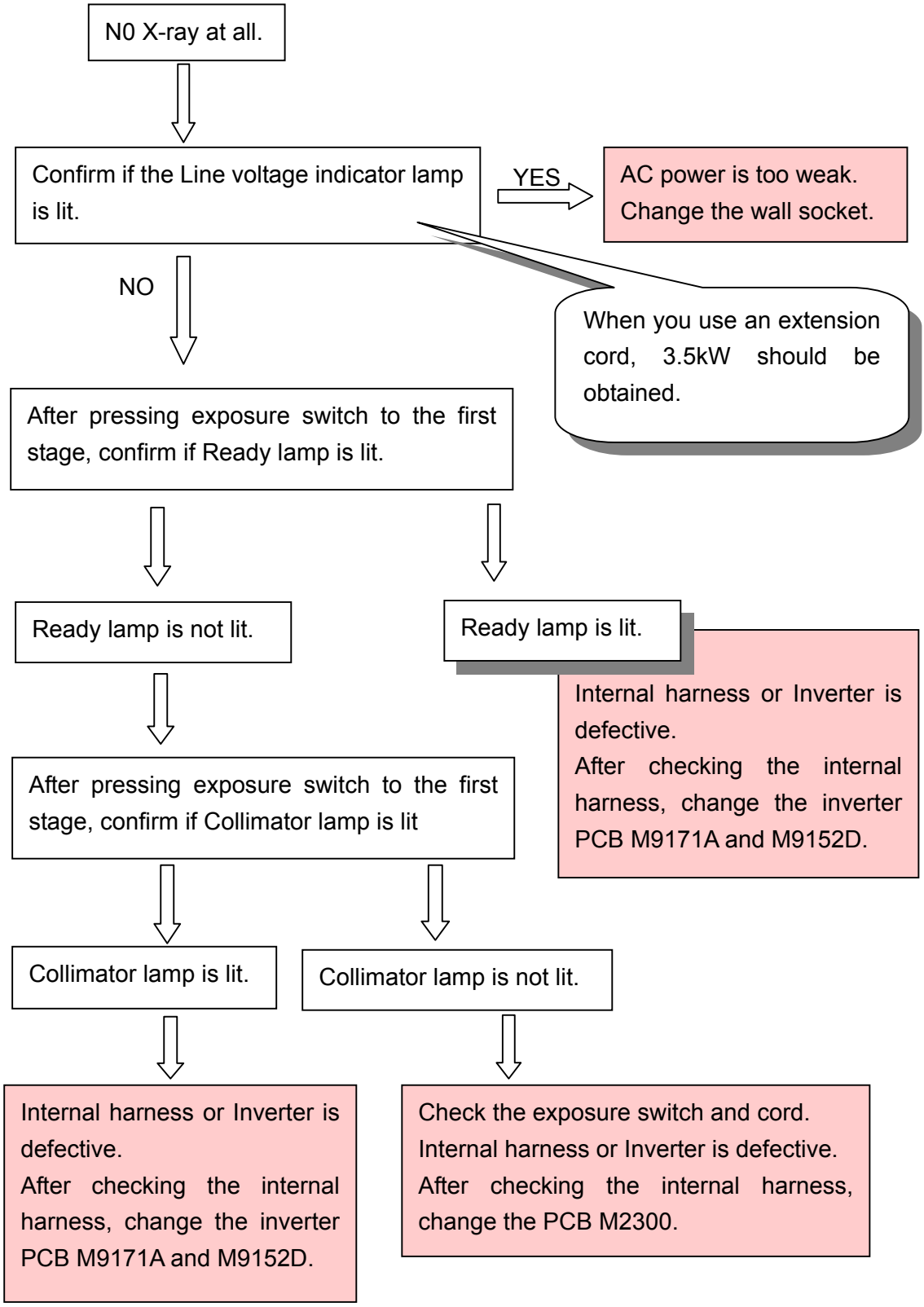

Q2
2SC1815
R18
10k
R17
10k
C8
106
R16
510k
U2
NE555
VCC
GND
DIS
THR
TRIG
CVolt
R
Q
R15
47k
C7
104
R5
10k
C5
104
PT1
TLP541G
C4
103
R4
1k
C3
104
U1B
LM358
PT2
TLP521
Q1
A1015
R6
1.5k
R7
20k
R8
20k
R3
3.3k
VR1
10k
R1
10k
R2
3.3k
C2
104
C1
25V/470uF
D1
WO2
T1
T28-2212
J1
B 6P-VH
J4
HNC2-2.5P-12DS
D2
1S2076A
R9
1.5k
D1
1S2076A
U1A
LM358N
D3
1S2076A
R10
15k
R11
1k
C6
104
R14
10k
R12
0.2
R13
0.2
J3
HNC2-2.5P-8DS
J2
B 2P-VH

15.0 TROUBLE – SHOOTING GUIDE

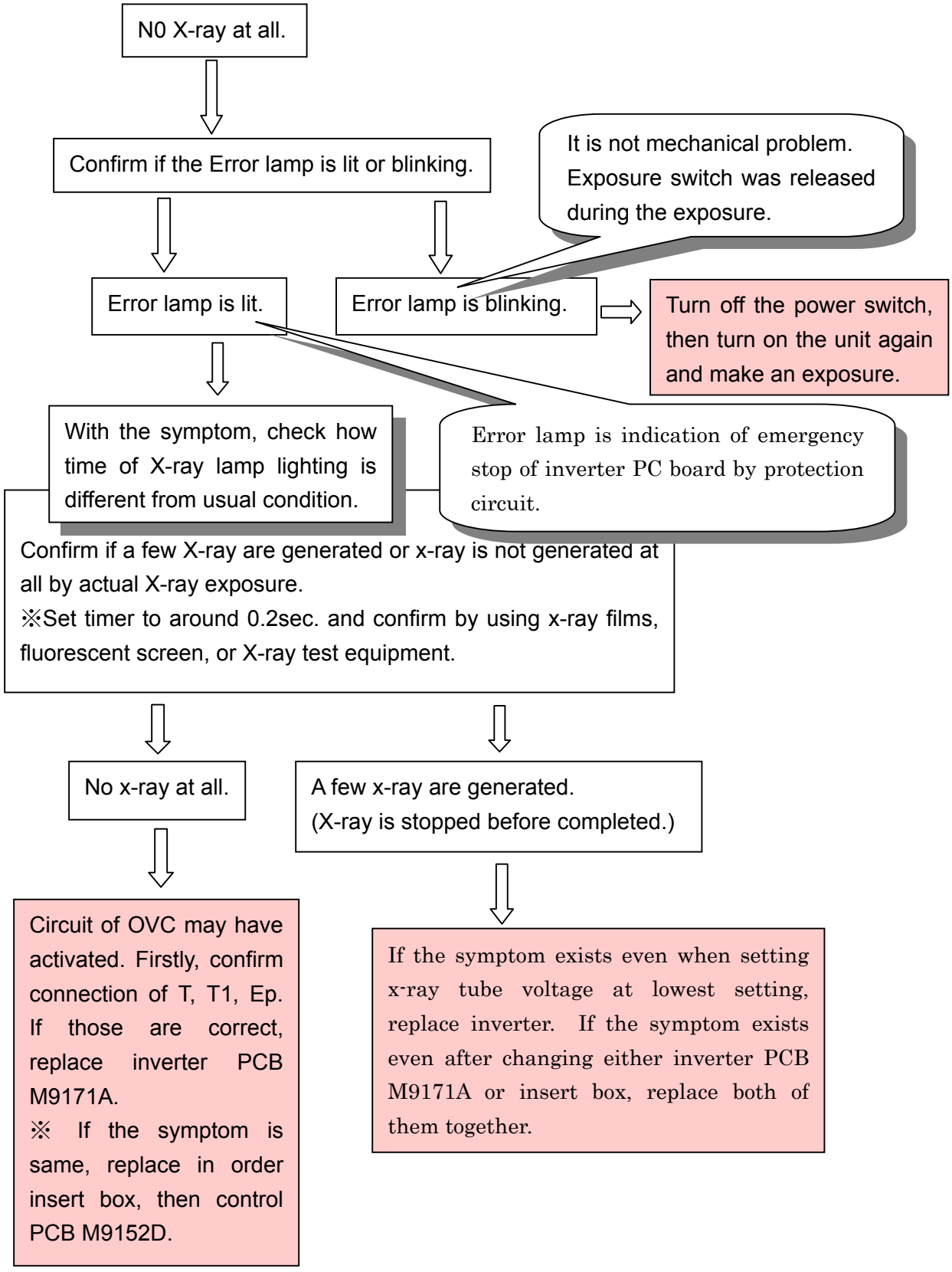
1.0 INDICATOR LAMPS ARE NOT LIT WHEN POWER SWITCH IS IN “ON” POSITION


Indicator lamps are not lit.
Check the wall socket, and confirm if it has bad connection.
Replace power cord if it is defective.
Confirm if the fuse is blown.
30A@125V
Confirm if the collimator lamp is lit.
Note:
Collimator has its own circuit and power system.
Collimator lamp is not lit.
Collimator lamp is lit.
Internal harness or Inverter is defective.
After checking the internal harness, change the inverter PCB M9171A.
Power supply (ZWS30-12) is defective.
After checking that the output of the power supply is 12V, change the M2300 firstly, and then change the M9152D and M2302B.

2.0 NO X-RAY AND ERROR LAMP IS NOT LIT


N0 X-ray at all.
Confirm if the Line voltage indicator lamp is lit.
YES
AC power is too weak.
Change the wall socket.
NO
When you use an extension cord, 3.5kW should be obtained.
After pressing exposure switch to the first stage, confirm if Ready lamp is lit.
Ready lamp is not lit.
Ready lamp is lit.
Internal harness or Inverter is defective.
After checking the internal harness, change the inverter PCB M9171A and M9152D.
After pressing exposure switch to the first stage, confirm if Collimator lamp is lit
Collimator lamp is lit.
Collimator lamp is not lit.
Internal harness or Inverter is defective.
After checking the internal harness, change the inverter PCB M9171A and M9152D.
Check the exposure switch and cord.
Internal harness or Inverter is defective.
After checking the internal harness, change the PCB M2300.

3.0 ERROR LAMP IS LIT AND NO X-RAY.


N0 X-ray at all.
Confirm if the Error lamp is lit or blinking.
It is not mechanical problem. Exposure switch was released during the exposure.
Error lamp is lit.
Error lamp is blinking.
Turn off the power switch, then turn on the unit again and make an exposure.
With the symptom, check how time of X-ray lamp lighting is different from usual condition.
Error lamp is indication of emergency stop of inverter PC board by protection circuit.
Confirm if a few X-ray are generated or x-ray is not generated at all by actual X-ray exposure.
※Set timer to around 0.2sec. and confirm by using x-ray films, fluorescent screen, or X-ray test equipment.
No x-ray at all.
A few x-ray are generated.
(X-ray is stopped before completed.)
Circuit of OVC may have activated. Firstly, confirm connection of T, T1, Ep. If those are correct, replace inverter PCB M9171A.
※ If the symptom is same, replace in order insert box, then control PCB M9152D.
If the symptom exists even when setting x-ray tube voltage at lowest setting, replace inverter. If the symptom exists even after changing either inverter PCB M9171A or insert box, replace both of them together.

BEAM QUALTY (HALF VALUE LAYER)

a. Test method:

1. Set kV to 40 kV, and timer to 0.2 sec.
2. Set NERO as following settings.
   SID: 18 inches, wheel range: 35 ～ 60 kV, sensitivity: Hi, phase select: 3 ϕ
   measurement mode: SGL x-ray values: 40kV, 0.2sec.
3. Make first exposure.
4. Put filter on the detector and make second exposure.
5. Press HVL button on NERO, input thickness of filter, and press enter.
6. Measure HVL value at 40kV.
7. Set kV to 50kV and 60kV with same procedure.
8. Set NERO as following settings.
   SID: 18 inches, wheel range: 70 ～ 120 kV, sensitivity: Low, phase select: 3 ϕ
   measurement mode: SGL x-ray values: 70kV, 0.2sec.
9. Make exposure.
10. Put filter on the detector and make second exposure to NERO.
11. Press HVL button on NERO, input thickness of filter, and press enter.
12. Measure HVL value at 70kV.
13. Measure HVL value at 80kV to 120kV with same procedure.

b. Instruments: NERO Model 6000M x-ray beam analyzer serial No.724
Manufactured by Victoreen, Inc.

c. Sample raw test data:

kV setting	HVL
40 kV	1.755 mAl
50kV	1.908 mAl
60 kV	2.32 mAl
70 kV	2.73 mAl
80 kV	3.23 mAl
90 kV	3.52 mAl
100 kV	4.27 mAl
110 kV	4.49 mAl
120 kV	4.84 mAl

REPRODUCIBILITY(C.V.)

a. Test method:

1. Set kV to 120 kV, and timer to 0.01 sec.
2. Set NERO as following settings.
   SID: 18 inches, wheel range: 70 ～ 120 kV, sensitivity: Low, phase select: 3 ϕ
   measurement mode: STAT x-ray values: 120kV, 0.01sec.
3. Make first exposure.
4. Close collimator, set timer to 0.1 sec., and make another exposure.
5. Open collimator, reset timer to original setting and make second exposure.
6. Continue above 4 and 5 for 10 times with 30 sec. interval between each exposure.
7. Press EXIT button of NERO and print out the result at STAT mode.
8. Measure also at 0.02 sec to 0.1 sec., 0.5, 1.0, 2.5 , 5.00 sec. with same procedure.
   Timer setting for each of them for procedure of above 4 is set time plus 0.1 sec.

b. Instruments: NERO Model 6000M x-ray beam analyzer serial No.724
Manufactured by Victoreen, Inc.

c. Sample raw test data:

timer setting	C.V. value
0.01 sec.	0.0212
0.02 sec.	0.0151
0.03 sec.	0.0131
0.04 sec.	0.0071
0.05 sec.	0.0078
0.06 sec.	0.0088
0.07 sec.	0.0005
0.08 sec	0.0053
0.09 sec	0.0012
0.10 sec	0.0013
0.50 sec	0.0039
1.00 sec	0.0051
2.50 sec	0.0072
5.00 sec	0.0057

PEAK TUBE POTENTIAL(kV)

a. Test method:

1. Set kV to 40 kV, and timer to 0.2 sec.
2. Set NERO as following settings.
   SID: 18 inches, wheel range: 35 ～ 60 kV sensitivity: Hi, phase select: 3 ϕ
   measurement mode: SGL x-ray values: 40kV, 0.2 sec.
3. Make exposure and measure value of avg. kV.
4. Measure value of avg. kV .
5. Set kV to 60 kV, and timer to 0.2 sec
6. Set NERO as following settings.
   SID: 18 inches, wheel range: 50 ～ 85 kV sensitivity: Hi, phase select: 3 ϕ
   measurement mode: SGL x-ray values: 60kV, 0.2 sec.
7. Make exposure.
8. Measure avg. kV value at 60kV, 70kV, 80kV with same procedure.
9. Set NERO as following settings.
   SID: 18 inches, wheel range: 70 ～ 120kV sensitivity: Hi, phase select: 3 ϕ
   measurement mode: SGL x-ray values: 90kV, 0.2 sec.
10. Make exposure.
11. Measure avg. kV value at 90kV, 100kV, 110kV , 120kV with same procedure

b. Instruments: NERO Model 6000M x-ray beam analyzer serial No.724
Manufactured by Victoreen, Inc.

c. Sample raw test data:

kV setting	kV value
40kV	38.3kV
50 kV	49.5kV
60 kV	58.6kV
70 kV	69.3kV
80 kV	80.4 kV
90kV	89.5kV
100kV	100.1kV
110kV	111.8kV
120kV	119.4kV

TUBE CURRENT(mA)

a. Test method:

1. Set kV to 40 kV, and timer to 0.2 sec.
2. Set oscilloscope as following settings.
   ch 1: Ep, ch 2: Ip, ch1 V/div: 500mV, ch2 V/div: 500 mV, sec/div: 25 msec,
3. Connect ch1 of oscilloscope to EP pin of M9152C and connect ch2 of oscilloscope to IP pin of M9152C. Connect GND line of probe to GND pin of M9152C.
4. Measure Hi value of ch2.
5. Measure Hi value of ch 2 at following kV settings, and timer to 0.2 sec with same procedure.

b. Instruments: Digital oscilloscope TDS310P serial No.J300159
Manufactured by Tectoronix , Inc.

c. Sample raw test data:

kV setting	1st Hi value	2nd Hi value
40 kV	3.02 V	2.11 V
50 kV	3.02 V	2.11 V
60 kV	2.54 V	1.78 V
70 kV	2.26 V	1.58 V
80 kV	1.90 V	1.33 V
90 kV	1.66 V	1.16 V
100 kV	1.50 V	1.05 V
110 kV	1.02 V	0.71 V
120 kV	1.02 V	0.72 V

d. Calculations: mA = (raw test data) V × 20

kV setting	1st mA value	2nd mA value
40 kV	60.4 mA	42.2 mA
50 kV	60.4 mA	42.2 mA
60 kV	50.8 mA	35.6 mA
70 kV	45.2 mA	31.6 mA
80 kV	38.0 mA	26.6 mA
90 kV	33.2 mA	23.2 mA
100 kV	30.0 mA	21.0 mA
110 kV	20.4 mA	14.2 mA
120 kV	20.4 mA	14.4 mA

EXPOSURE TIME(sec)

a. Test method:

1. Set kV to 120 kV and timer to 0.01 sec.
2. Set NERO as following settings.
   SID: 18 inches, wheel range: 70 ～ 120 kV sensitivity: Low, phase select: 3 ϕ
   measurement mode: STAT x-ray values: 120kV, 0.01 sec.
3. Make exposure and read value of exposure time .
5. Measure value of exposure time at following settings with same procedure.

b. Instruments: NERO Model 6000M x-ray beam analyzer serial No.724
Manufactured by Victoreen, Inc.

c. Sample raw test data

timer setting	measured value
0.01sec.	0.0109 sec
0.02 sec.	0.0192 sec
0.03 sec.	0.0292 sec
0.04 sec.	0.0388 sec
0.05 sec	0.0487 sec
0.06 sec	0.0586 sec
0.07 sec	0.0684 sec
0.08 sec	0.0785 sec
0.09 sec	0.0882 sec
0.10 sec	0.0985 sec
0.20 sec	0.196 sec
0.30 sec	0.300 sec
0.40 sec	0.398 sec
0.50 sec	0.497 sec
0.60 sec	0.595 sec
0.70 sec	0.694 sec
0.80 sec	0.792 sec
0.90 sec	0.891 sec
1.00 sec	0.989 sec
2.00 sec	1.965 sec
3.00 sec	2.98 sec
4.00 sec	3.94 sec
5.00 sec	4.97 sec

Appendix.

Parts List for HF120/60HPPWV

As of 2005/3/4

Photo. No.	Parts No.	Designation	Qty
1	10714	LED INDICTING LAMP (ORANGE)	1
2	10713	LED INDICTING LAMP (GREEN)	1
3	10715	LED INDICTING LAMP (RED)	1
4	10707	WIRE PROTECTOR	1
5	11260	LOW LINE VOLTAGE INDICATOR	1
6	11258	UPPER CASE (YELLOW)	1
7	11261	METAL PLATE (LABEL FOR INDICATOR)	1
8	11262	METAL PLATE (SHEET KEY PLATE)	1
9	11263	Label for LED indicator	1
10	11264	SHEET KEY PLATE	1
11	11265	PCB M2303	1
12	11270	WIRES WITH CONNECTOR(M2300-M2302B)	1
13	11267	EXPOSURE SWITCH CORD RECEPTACLE	1
14	11005	MOUNTING METAL FOR EXPOSURE SWITCH SOCKET	1
15	11257	BATTERY CASE FOR MEMORY SETTING	1
16	11075	SPACER (EM-3.5)	4
17	11266	PCB M2300 for HF120/60H	1
18	11273	WIRES WITH (AC-DC converter - M9152D)	1
19	11275	AC-DC converter (ZWS30-12/J)	1
20	11269	POWER SUPPLY with wires, fuse and connectors	1
21	11336	WIRES WITH (AC-DC converter - M2302B)	1
21	11336	WIRES WITH (AC-DC converter - M2302B)	1
22	11272	PCB M2302B	1
23	11274	WIRES WITH CONNECTOR(M9152D-2302 B)	1
24	11220	PCB M9152D for HF120/60H	1
25	11271	WIRES WITH CONNECTOR(7P, M9152D-M9171A)	1
26	11276	WIRES WITH CONNECTOR(2P, M9152D-M9171A)	1
27	11255	FIXING METAL FOR INSERT (TOP)	1
28	11254	CHASSIS	1
29	10697	SPACER(M3 x 5)	12
30	10126	BRASS RING	1
31	11252	SIDE FRAME (L)	1
32	11253	SIDE FRAME (R)	1
33	11251	INSERT for HF120/60H	1
34	11222	SCREW (bolt, M4 x 10)	4
35	11250	COLLIMATOR FLANGE (ADVANTECH)	1
36	10736	SPACER FOR COLLIMATOR	2
37	10756	FRONT PANEL (YELLOW)	1
38	11221	COLLIMATOR MOUNTING PLATE	2
39	11256	PCB M9171A(Inverter)	1
40	11268	mA JACK TERMINAL	1
41	10742	POWER RECEPTACLE	1
42	10688	FUSE HOLDER	2

Parts List for HF120/60HPPWV

As of 2005/3/4

43	11249	POWER SWITCH	1
44	10586	PLASTIC FOOT	4
45	11248	LOWER CASE	1
46	10082	METAL SPACER	2
47	10083	SPLIT LOCK WASHER	2
48	10084	HOLDING SCREW	2
49	10690	MOUNTING PLATE (WITHOUT DEGREES)	2
50	10818	HOLDING PARTS	2
51	10081	NYLON WASHER	6
52	11213	Collimator (Advantech R72/32)	1
53	10076	ORNAMENT WASHER FOR ORNAMENT SCREW M3	4
54	10075	ORNAMENT SCREW (EP-M3 X 8)	4
55	11162	EXPOSURE SWITCH(HS-M1)	1
56	11337	EXPOSURE SWITCH CORD for HS-M1 (7.6m straight)	1

Parts List for HF120/60HPPWV

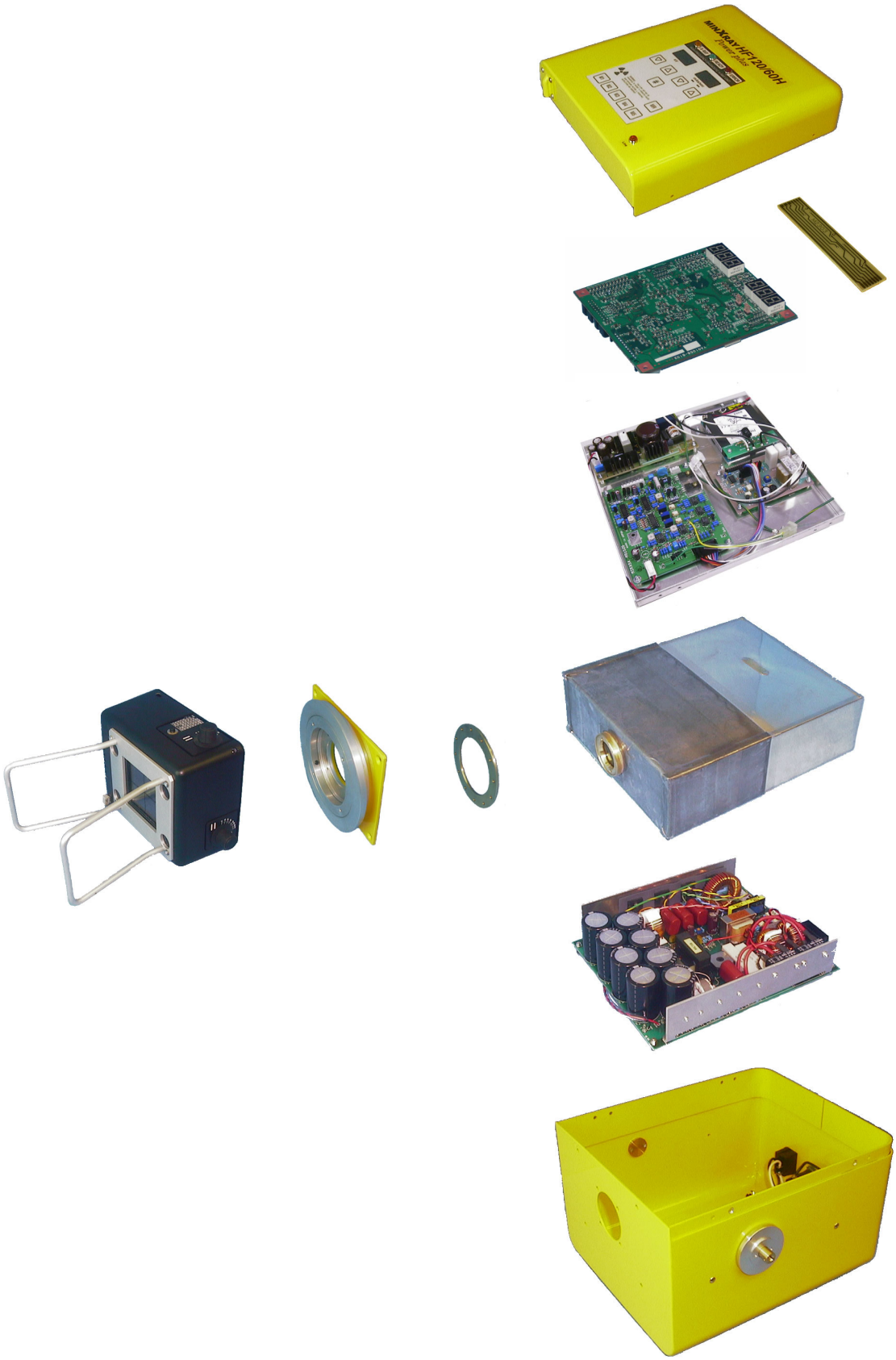
(insert)

As of 2005/3/4

Photo. No.	Parts No.	Designation	Qty
i1	11279	Chassis for PCB M9160	1
i2	11280	PCB M9160 (High tension PC Board)	1
i3	11281	OUTERCASE OF INSERT (inc. Hermetic seal)	1
i4	11282	SPACER FOR M9160 (Black)	2
i5	11283	SCREW FOR M9160 (Clear)	4
i6	11284	SPACER FOR M9160 (Metal)	2
i7	11285	SCREW FOR M9160 (Metal)	4
i8	11286	O ring	1
i9	11287	Window	1
i10	11288	Thrust ring	1
i11	11289	Aperture ring	1
i12	11290	X-RAY TUBE (Superior, SXR-130-15-1.2) ASSEM.	1
i13	11291	INSULATION FILM FOR X-RAY TUBE ASSEM.	10
i14	11292	INSULATION FILM (Front)	7
i15	11293	INSULATION FILM (Center)	7
i16	11294	INSULATION FILM (Large)	15
i17	11295	INSULATION FILM FOR PROTECTING REAR TERMINAL	1
i18	11296	Lead (Right, double)	1
i19	11297	Lead (Front)	1
i20	11298	Lead (Left)	1
i21	11299	Wire assembly (Insert - Control PCB) ---Type 1	1
i22	11300	Wire assembly (Insert - Control PCB) ---Type 2	1
i23	11301	Wire assembly (Insert - Inverter PCB)	1
i24	11302	Neon tube	2

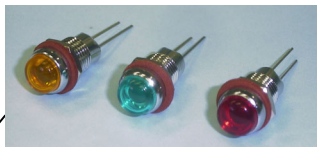
As of 2005/03/04

HF120/60HPPWV parts list (Photos) 1/11



As of 2005/03/04

HF120/60HPPWV parts list (Photos) 2/11



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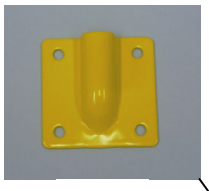

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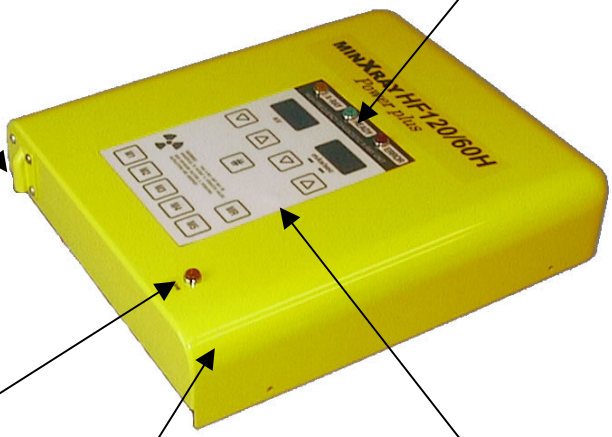

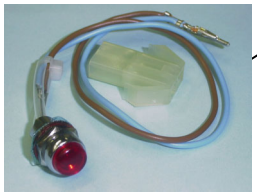

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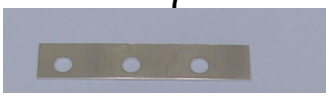

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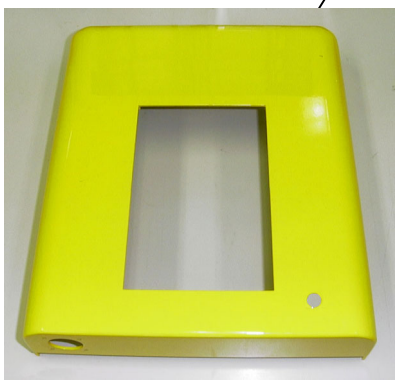

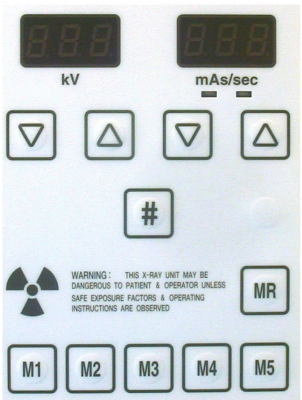

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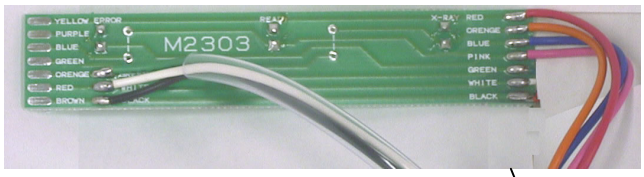
As of 2005/03/04

HF120/60HPPWV parts list (Photos) 3/11



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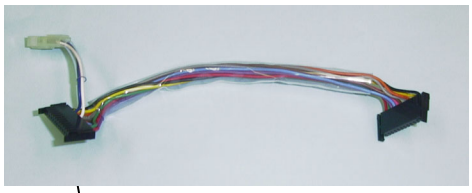

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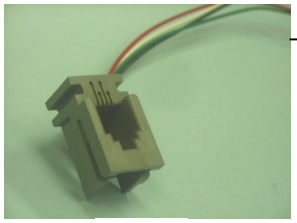

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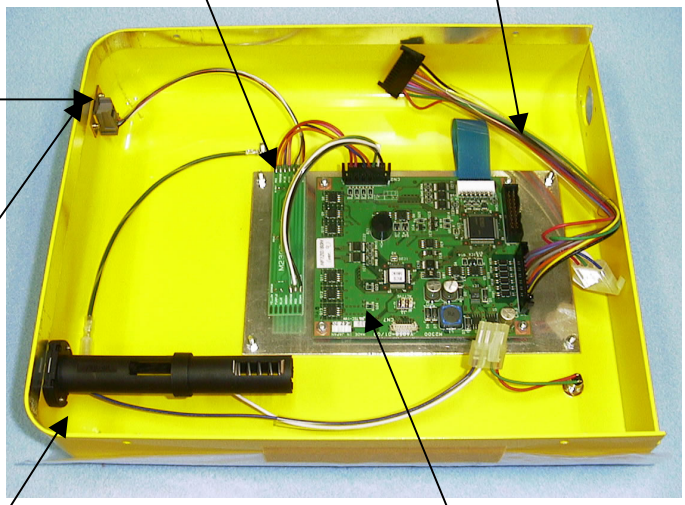

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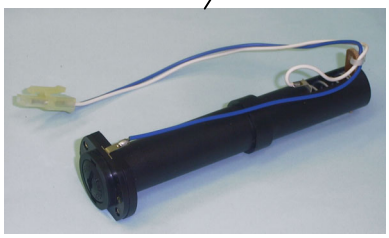

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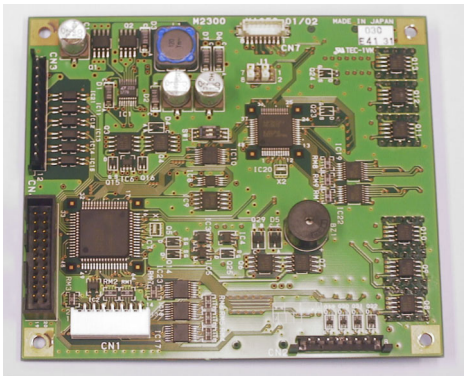

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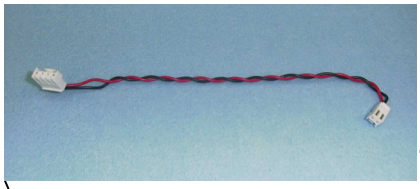
As of 2005/03/04

HF120/60HPPWV parts list (Photos) 4/11



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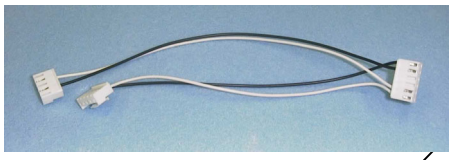

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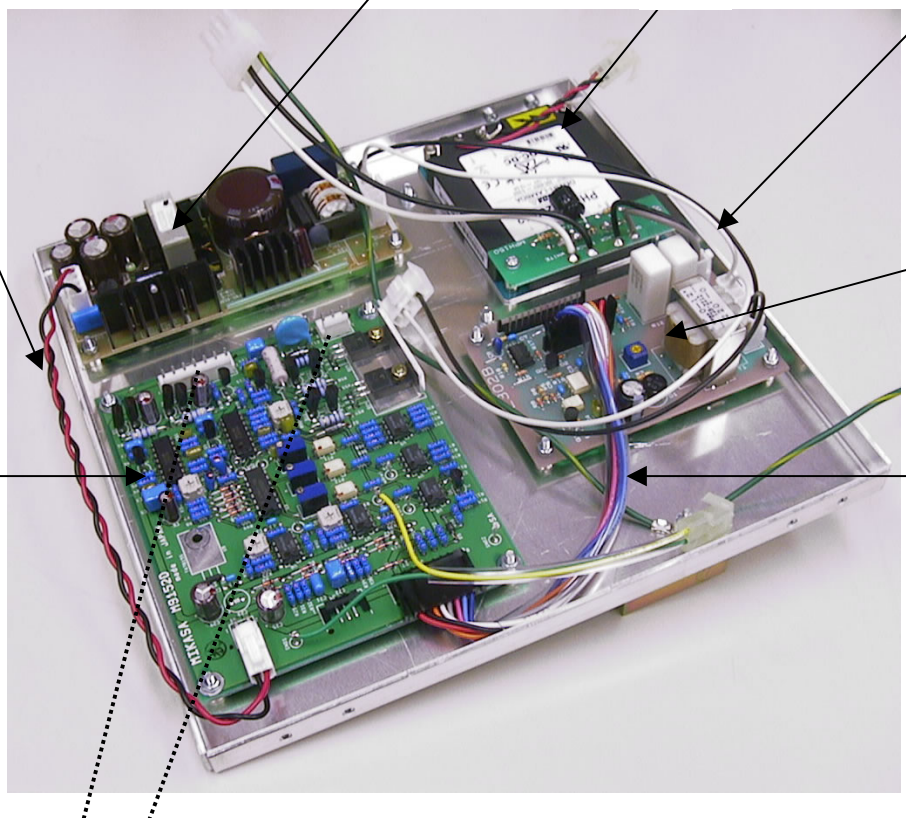

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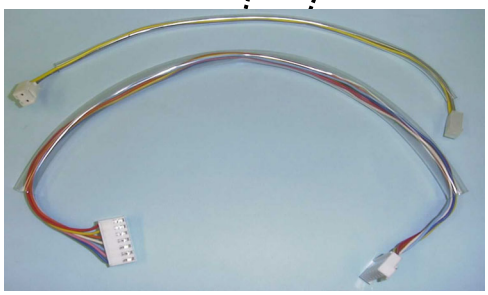

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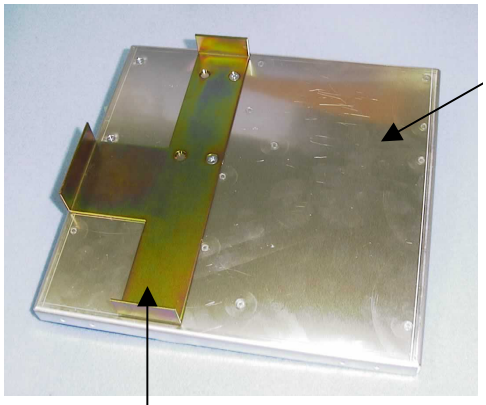

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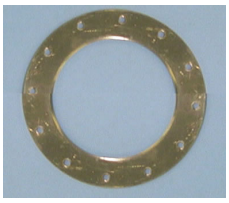
As of 2005/03/04

HF120/60HPPWV parts list (Photos) 5/11



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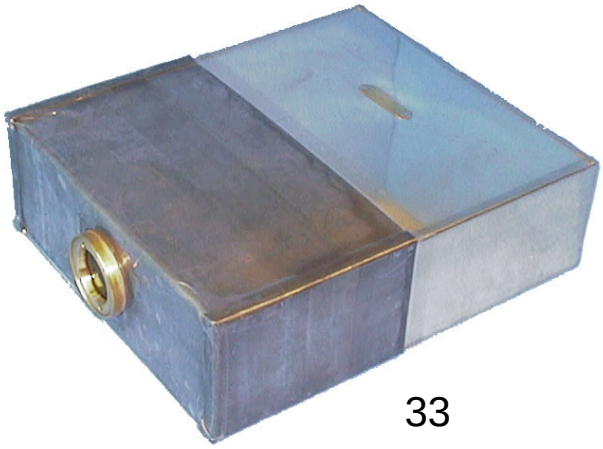

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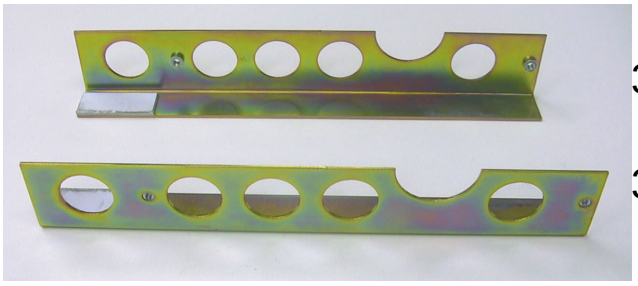

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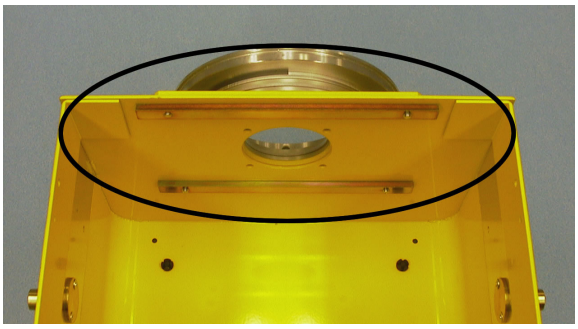

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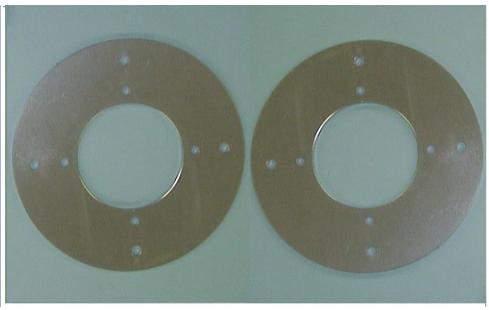

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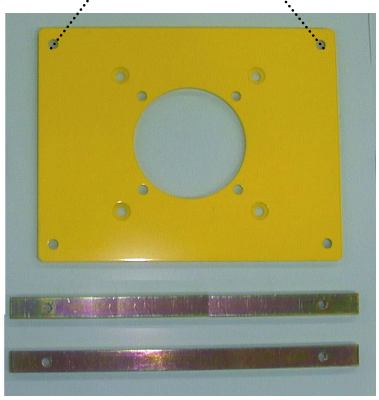

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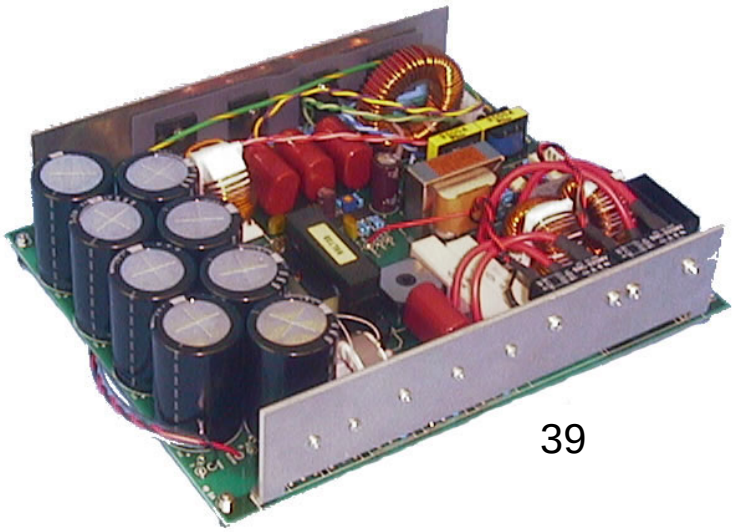
As of 2005/03/04

HF120/60HPPWV parts list (Photos) 6/11



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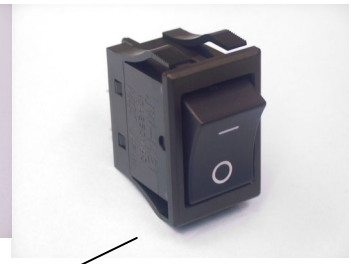

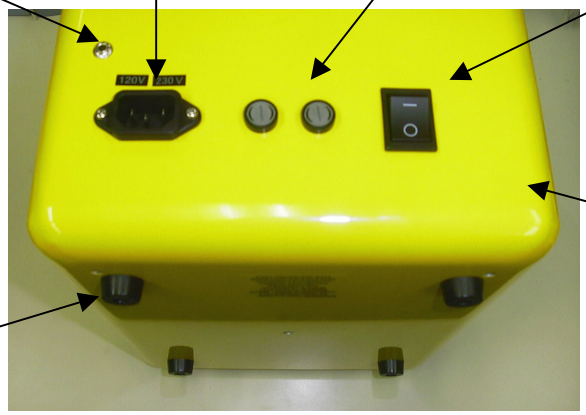

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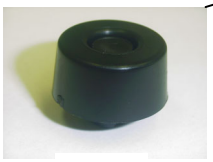

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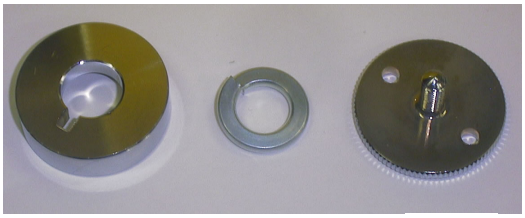
As As of 2005/03/04

HF120/60HPPWV parts list (Photos) 7/11



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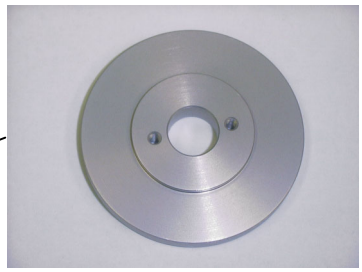

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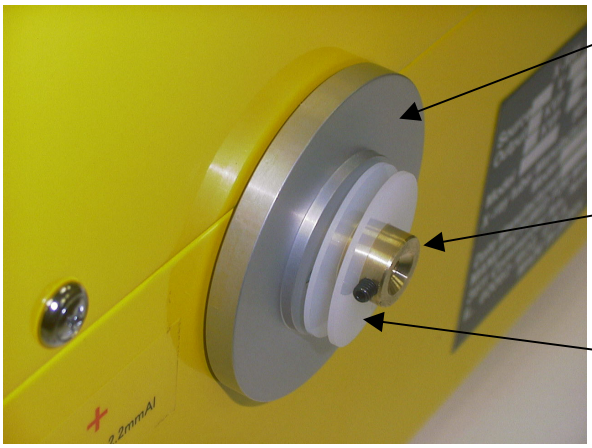

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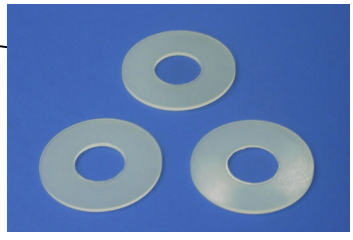

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As of 2005/03/04

HF120/60HPPWV parts list (Photos) 8/11

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As As of 2005/03/04

HF120/60HPPWV parts list (Photos) 9/11
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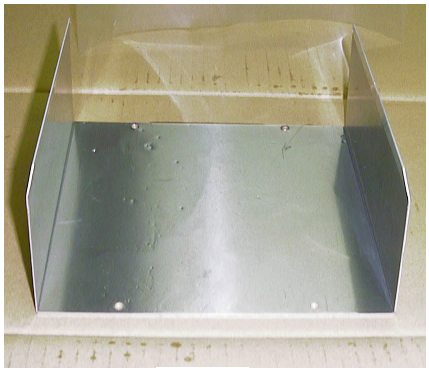

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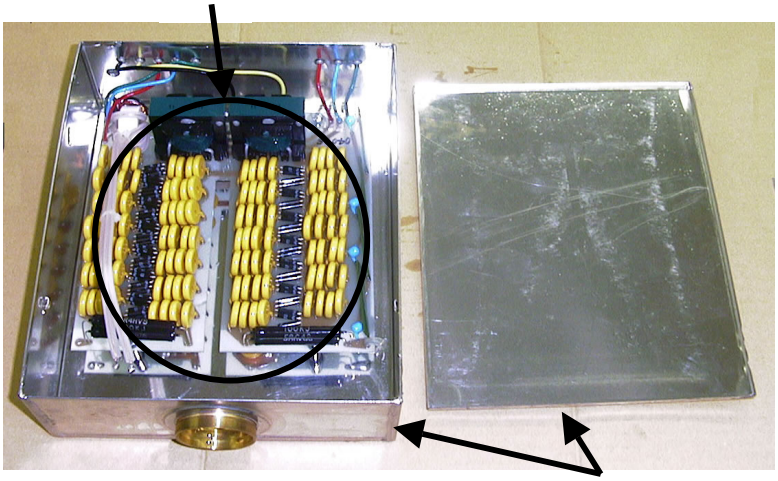

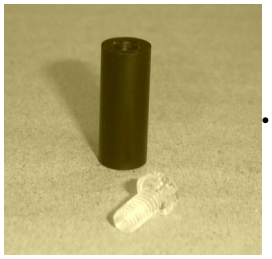

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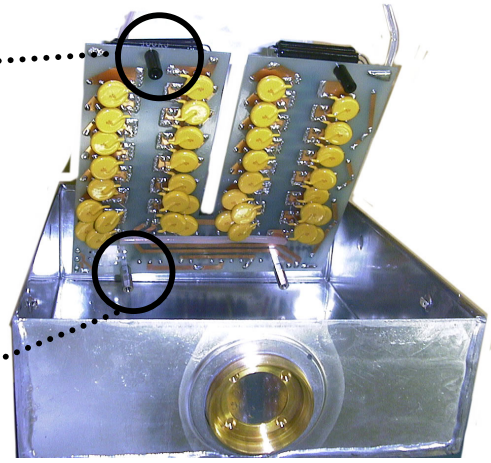

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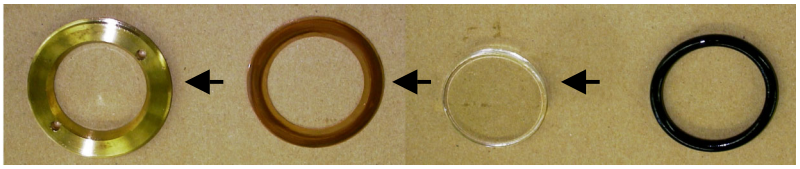

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As As of 2005/03/04

HF120/60HPPWV parts list (Photos) 10/11
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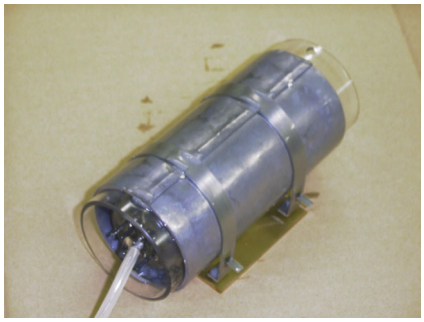

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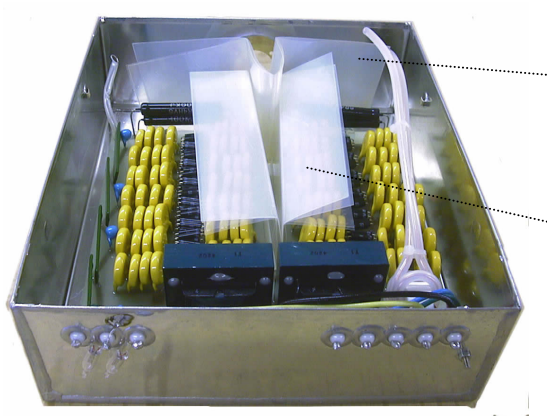
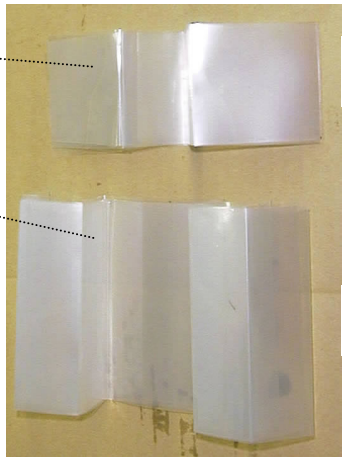
i13





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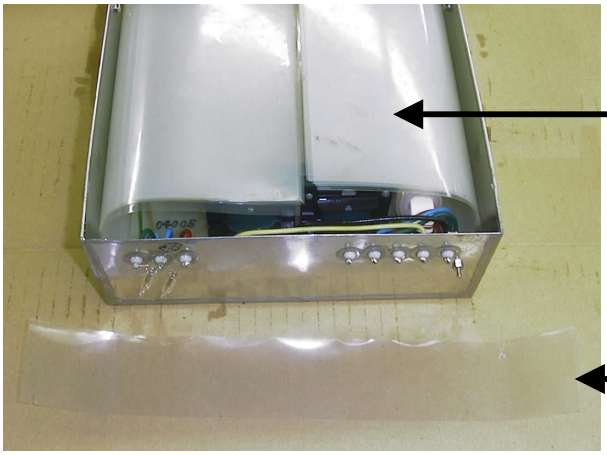

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i17

As As of 2005/03/04

HF120/60HPPWV parts list (Photos) 11/11
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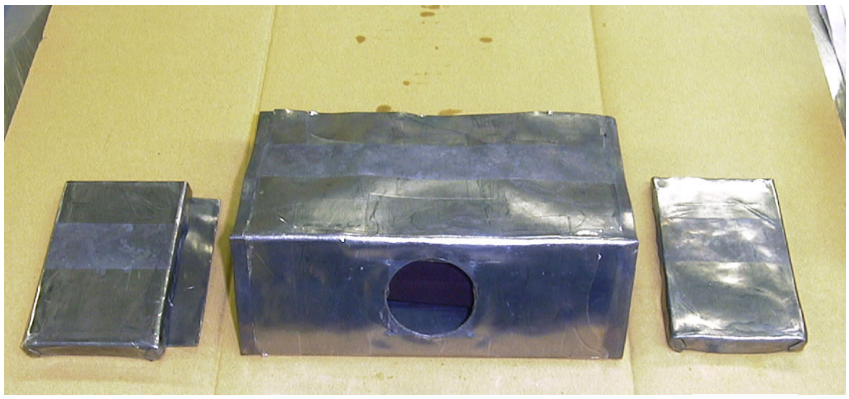

i18 i19 i20